Final 3 10 026

Remedial Investigation Report

Phase I & II

Medley Farm Site

Gaffney, South Carolina

Volume II

February 1991

SIRRINE
ENVIRONMENTAL
CONSULTANTS

APPENDIX A

REMEDIAL INVESTIGATION ANALYTICAL SUMMARY

MEDLEY FARM SITE

REFERENCE: MEDLEY FARM SITE

DRAFT REMEDIAL INVESTIGATION REPORT

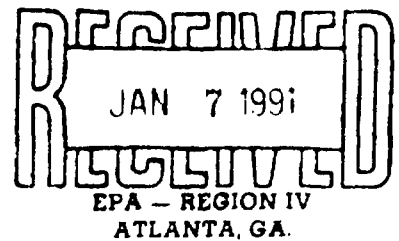SIRRINE ENVIRONMENTAL CONSULTANTS

DECEMBER 1990

TABLE 5.3
MEDLEY FARM SITE RI
ANALYTICAL DATA SUMMARY
ORGANIC COMPOUNDS DETECTED
IN
SOILS (ug/kg)

SAMPLE ID / COMPOUND	TP1-1	TP2-1	TP3-1	TP4-1	TP5-1	TP7-1	TP8-1	TP9-1	TP12-1	TP13-1	TP14-1	TP15-1
1,1-Dichloroethene			140 E	14								
1,1-Dichloroethane				47								
1,1,1-Trichloroethane				560 E								
1,1,2-Trichloroethane				71								
1,1,2,2-Tetrachloroethane				3400 E								
1,2-Dichloroethane									90			
1,2-Dichloroethene (total)			12000 E	730 E							250	
2-Butanone				81			1000					
4-Methyl-2-pentanone				16			390					
Acetone	12			2300 E			870	580 DE				
Benzene			600 E	160								
Carbon Disulfide			450 E									
Chlorobenzene			2500 E	360 E								
Ethylbenzene			1200 E	110							70	
Methylene Chloride				800 E						24	31	
Styrene				110								
Tetrachloroethene (PCE)			61000 E	5400 E					3 J		10	
Toluene			12000 E	1300 E							15	
Trichloroethene			12000 E	6600 E	8	280 D			31			16
Vinyl Acetate				13								
Vinyl Chloride			500 E								69	
Xylene (Total)		3.7	3900 E	620 E			170				250	

Data Flags:
    D- Sample diluted for this analyte.
    E- Estimated result. Analyte concentration exceeded the instrument calibration range.

Notes:
    No volatile organic compounds were detected in soil samples collected from test pits TP6, TP10, TP11, and TP16.

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TABLE 5.3 (continued)   Page 2 of 8
MEDLEY FARM SITE RI
ANALYTICAL DATA SUMMARY
ORGANIC COMPOUNDS DETECTED
IN
SOILS (ug/kg)

SAMPLE ID COMPOUND	TP2-1	TP3-1		TP4-1		TP5-1	TP7-1
2-Methylnaphthalene	550						
1,2,4-Trichlorobenzene		710000	D	240000	D		
Acenaphthalene				75000			
Phenol				94000	D		
Bis(2-Ethylhexyl)phthalate						161000	630

Data Flags:
    D - Sample diluted for this analyte.

Notes:
    No semi-volatile organic compounds were detected in soil samples collected from test pits TP1 and TP9.
    Soil samples collected from test pits TP6 and TP8 were not analyzed for semi-volatile organic compounds.

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TABLE 5.3 (continued)   Page 3 of 8
MEDLEY FARM SITE RI
ANALYTICAL DATA SUMMARY
ORGANIC COMPOUNDS DETECTED
IN
SOILS (ug/kg)

1,1,2,2-TETRACHLOROETHANE

Sample	Soil Boring Number		
Depth	SB2	SB5	SB6
5 - 7'	*	nd	6
10 - 12'	710 D	nd	*
15 - 17'	97 D	9	nd
25 - 27'	74 D	nd	nd

METHYLENE CHLORIDE

Sample	Soil Boring Number	
Depth	SB3	SB4
5 - 7'	*	*
10 - 12'	50	10
15 - 17'	nd	32
25 - 27'	nd	17

CHLOROFORM

Sample	Soil Boring Number	
Depth	SB2	SB6
5 - 7'	*	13
10 - 12'	600 D	*
15 - 17'	nd	nd
25 - 27'	nd	nd

TRICHLOROETHENE

Sample	Soil Boring Number	
Depth	SB4	SB7
5 - 7'	*	24
10 - 12'	19	*
15 - 17'	32	nd
25 - 27'	17	nd

1,2-DICHLOROETHANE

Sample	Soil Boring Number			
Depth	SB4	SB7	SB9	SB10
5 - 7'	*	97	*	23
10 - 12'	3700 D	*	47	*
15 - 17'	4500 D	nd	32	nd
25 - 27'	680 D	nd	99	nd

Data Flags:
  D- Sample diluted for this analyte.
  E - Estimated result. Analyte concentration exceeded the instrument calibration range.

Notes:
  nd - Not detected
  * - Not analyzed.

2-Butanone was detected in boring SB2 at 15 - 17' at 90 ug/kg in the diluted sample.
1,2 Dichloroethene (total) was detected in boring SB3 at 10 - 12' at 17 ug/kg.
PCE was detected in boring SB7 at 5 - 7' at 12 ug/kg.
Results are reported only for borings in which analytes were detected. Complete tables of analytical results are provided in Appendix I.

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TABLE 5.3 (continued)   Page 4 of 8
MEDLEY FARM SITE RI
ANALYTICAL DATA SUMMARY
ORGANIC COMPOUNDS DETECTED
IN
SOIL (ug/kg)

ACETONE

Sample Depth	Soil Boring Number			
	SB2	SB3	SB4	SB5
5 - 7'	*	*	*	nd
10 - 12'	18000 DE	140	200	21
15 -17'	7300 DE	55	1900 D	570 D
25 - 27'	750 D	16	100	nd

ACETONE (continued)

Sample Depth	Soil Boring Number				
	SB6	SB7	SB8	SB9	SB10
5 - 7'	58	4700 D	86	*	31
10 - 12'	*	*	*	94	4
15 -17'	nd	120	58	110	40
25 - 27'	nd	18	250 D	nd	65

Data Flags:
     D- Sample diluted for this analyte.
     E - Estimated result. Analyte concentration exceeded the instrument calibration range.

Notes:
     nd - Not detected
     * - Not analyzed

2-Butanone was detected in boring SB2 at 15 - 17' at 90 ug/kg in the diluted sample.
1,2-Dichloroethene (total) was detected in boring SB3 at 10 - 12' at 17 ug/kg.
PCE was detected in boring SB7 at 5 - 7' at 12 ug/kg.
Results are reported only for borings in which analytes were detected. Complete tables of analytical results are provided in Appendix I.

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TABLE 5.3 (continued)   Page 5 of 8
MEDLEY FARM SITE RI
ANALYTICAL DATA SUMMARY
ORGANIC COMPOUNDS DETECTED
IN
SOIL (ug/kg)

1,2-DICHLOROBENZENE

Sample Depth	Soil Boring Number SB3
5 - 7'	*
10 - 12'	nd
15 - 17'	460
25 -27'	nd

NAPHTHALENE

Sample Depth	Soil Boring Number SB3
5 - 7'	*
10 - 12'	nd
15 - 17'	410
25 -27'	nd

PHENOL

Sample Depth	Soil Boring Number SB2
5 - 7'	*
10 - 12'	77000
15 - 17'	nd
25 -27'	690

1,4-DICHLOROBENZENE

Sample Depth	Soil Boring Number SB3
5 - 7'	*
10 - 12'	nd
15 - 17'	2300
25 -27'	nd

DIETHYLPHTHALATE

Sample Depth	Soil Boring Number SB3
5 - 7'	*
10 - 12'	nd
15 - 17'	nd
25 -27'	3200

BENZOIC ACID

Sample Depth	Soil Boring Number SB2
5 - 7'	*
10 - 12'	nd
15 - 17'	nd
25 -27'	2600

1,2,4-TRICHLOROBENZENE

Sample Depth	Soil Boring Number SB2	Soil Boring Number SB3
5 - 7'	*	*
10 - 12'	nd	700
15 - 17'	nd	12000
25-27'	5200	nd

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Notes:
   nd - Not detected
   * - Not analyzed

Results are reported only for borings in which analytes were detected.
Complete tables of analytical results are provided in Appendix I.

TABLE 5.3 (continued)   Page 6 of 8

MEDLEY FARM SITE RI
ANALYTICAL DATA SUMMARY
ORGANIC COMPOUNDS DETECTED
IN
SOILS (ug/kg) - See Note

SAMPLE I.D.	HA-1	HA-2	HA-3	HA-4	HA-5	HA-6	HA-7	HA-11	HA-6-A
PARAMETER									
1,1,2,2-Tetrachloroethane						91			85
1,1,2-Trichloroethane						160			110
1,2-Dichloroethene (total)	170	11		6			120		200
1,2-Dichloropropane							21		
Ethylbenzene				7				33	
Methylene chloride					6		23		
Styrene								11	
Tetrachloroethene					37	69			53
Trichloroethene	14					50	7		70
Vinyl chloride		25	25	28	210				

Note: This table represents preliminary data provided on electronic file.

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TABLE 5.3 (continued) Page 7 of 8
MEDLEY FARM SITE RI
ANALYTICAL DATA SUMMARY
ORGANIC COMPOUNDS DETECTED
IN
SOILS (ug/kg) - See Notes

3 10   0274

SAMPLE I.D.	HA-6	HA-6 DILUTION	HA-11
PARAMETER			
1,2,4-Trichlorobenzene	990 @	1100 DJ	1200 @
bis(2-Ethylhexyl)phthalate	29000 E	33000 D	
Butylbenzylphthalate	900 @	1100 DJ	
Di-n-butylphthalate	930 @	1100 DJ	
Di-n-octylphthalate	5400	4900 D@	

Notes: This table represents preliminary data provided on electronic file.
D - Sample diluted for this analyte.
J - Estimated result. Analyte detected at less than the sample quantitation limit.
E - Estimated result. Analyte concentration exceeded the instrument calibration range.
@ - Estimated result less than 5 times the detection limit.

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TABLE 5.3 (continued)   Page 8 of 8

MEDLEY FARM SITE RI
ANALYTICAL DATA SUMMARY
ORGANICS DETECTED
IN
SOILS (ug/kg) - See Note

3 10   0275

SAMPLE LOCATION	HA1	HA3	HA8	HA11
SAMPLE I.D.	HA1-2	HA3-2	HA8-2	HA11-2
PARAMETER				
Toxaphene	330			
PCB-1254		200	1900	430

Note: This table represents preliminary data provided on electronic file.

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TABLE 5.5
MEDLEY FARM SITE RI
INORGANIC CONCENTRATIONS (mg/kg)
IN
SURFACE SOILS - See Notes

SAMPLE I.D.	HA-4	HA-8	HA-9	HA-10	HA-13	HA-14	HA-15
PARAMETER							
Aluminum	29600	19800	48600	37100	24400	66800	33700
Antimony	BDL (a)	BDL (c)	BDL (a)	BDL (c)	14.7	24.9	10.7
Arsenic	21.6	15	29	28.8	15.6	40.9	25.3
Barium	134	89.1	96.8	89.1	44.6	95.8	77.9
Beryllium	BDL (a)	BDL (a)	BDL (a)	BDL (a)	BDL (a)	BDL (a)	BDL (a)
Cadmium	BDL (c)	BDL (c)	BDL (c)	BDL (c)	BDL (c)	BDL (c)	BDL (c)
Calcium	BDL (a)	BDL (a)	BDL (a)	BDL (a)	1030	BDL (a)	BDL (a)
Chromium	16.4	11.2	11.8	12	3.5	10.1	12.6
Cobalt	16.1 (b)	BDL (a)	BDL (a)	BDL (a)	BDL (a)	BDL (a)	14.6 (b)
Copper	9.6	11.2	27.1	19.6	BDL (a)	37.8	39.1
Iron	20800	18200	26400	24200	22200	30000	34700
Lead	34.9	15.6	25.8	12.8	12.2	13.3	20.1
Magnesium	994	BDL (a)	1030	BDL (a)	2380	1400	1370
Manganese	590	343	225	87.6	190	99.9	302
Mercury	BDL (c)	BDL (c)	BDL (c)	BDL (c)	BDL (c)	BDL (c)	BDL (c)
Nickel	6.8	BDL (a)	7.1	BDL (a)	BDL (a)	BDL (a)	BDL (a)
Potassium	1450	934	1710	1600	BDL (a)	1350	BDL (a)
Selenium	BDL (c)	BDL (c)	BDL (c)	BDL (c)	BDL (c)	BDL (c)	BDL (c)
Silver	BDL (a)	BDL (c)	BDL (a)	BDL (a)	BDL (a)	BDL (a)	BDL (c)
Sodium	BDL (c)	BDL (c)	BDL (c)	BDL (c)	BDL (c)	BDL (c)	BDL (c)
Thallium	BDL (c)	BDL (c)	BDL (c)	BDL (c)	BDL (c)	BDL (a)	BDL (c)
Vanadium	39.6	34.1	46.7	48.6	47.3	54.8	102
Zinc	37.6 (b)	54.4 (b)	74 (b)	30.9 (b)	48.1 (b)	42.2 (b)	32.5 (b)

Notes:
    (a) Below contract required detection limits.
    (b) Estimated result.
    (c) Below sample detection limit.

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TABLE 5.7
MEDLEY FARM SITE RI
ANALYTICAL DATA SUMMARY
VOLATILE ORGANIC COMPOUNDS DETECTED
IN
GROUND WATER (ug/l) - See Notes

SAMPLE LOCATION	BW1		SW1	BW2			SW3
SAMPLE I.D.	*BW1-3	BW1-4	SW1-4	BW2-1	BW2-2	BW2-3	SW3-1
SAMPLE DATE	09-28-90	11-27-90	11-27-90	08-09-89	01-10-90	09-28-90	08-08-89
PHASE	PHASE II	PHASE II (Resample)	PHASE II (Resample)	PHASE IA	PHASE IB	PHASE II	PHASE IA
PARAMETER							
Acetone	19		5 BJ			18	
Benzene							
Carbon tetrachloride							
Chloroform					10		
Chloromethane							
Methylene chloride		4 BJ	3 BJ	110 D			
Tetrachloroethene				35 D	18	8	190
Toluene							
Trichloroethene				720 D	530 D	140	140
1,1,2,2-Tetrachloroethane							
1,1,1-Trichloroethane				310 D	270 D	110	
1,1,2-Trichloroethane							
1,1-Dichloroethene				440 D	340 D	130	8
1,2-Dichloroethene (total)							9
1,1-Dichloroethane							
1,2-Dichloroethane				290 D	260 D	120	
2-Butanone							
2-Hexanone							

Notes:
1) No volatile organic compounds were detected in samples SW1-1, BW1-2, BW3-1, BW3-2, BW4-1 and BW4-2.
D - Sample diluted for this analyte.
E - Estimated result. Analyte concentration exceeded the instrument calibration range.
B - Analyte detected in the associated blank. Result not corrected.
J - Estimated result. Analyte detected at less than the sample quantitation limit.

* Raw data results for BW1-3, SW1-2, BW4-3 and SW106-3 were inconsistent with concentrations previously reported. These wells were subsequently resampled (Nov. 26 and 27, 1990) and samples were submitted to Ecotek Laboratory for analysis. The Ecotek results are indicated by the 'Resample' designation.

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TABLE 5.7 (continued)
Page 2 of 4

MEDLEY FARM SITE RI
ANALYTICAL DATA SUMMARY
VOLATILE ORGANIC COMPOUNDS DETECTED
IN
GROUND WATER (ug/l) - See Notes

SAMPLE LOCATION	SW3		BW4		SW4		
SAMPLE I.D.	SW3-2	SW3-3	*BW4-3	BW4-4	SW4-1	SW4-2	SW4-3
SAMPLE DATE	01-09-90	09-25-90	09-26-90	11-26-90	08-08-89	01-09-90	09-25-90
PHASE	PHASE IB	PHASE II	PHASE II	PHASE II (Resample)	PHASE IA	PHASE IB	PHASE II
PARAMETER							
Acetone							
Benzene							
Carbon tetrachloride			130				
Chloroform			74				
Chloromethane		15					
Methylene chloride				4 BJ			
Tetrachloroethene	200	190					
Toluene			9.5				
Trichloroethene	130	190	49				
1,1,2,2-Tetrachloroethane			19				
1,1,1-Trichloroethane		5.6			3400 D	2800 E	2500 D
1,1,2-Trichloroethane			18		8	13	
1,1-Dichloroethene					1800 D	2100 E	2200 D
1,2-Dichloroethene (total)		5.4				31	
1,1-Dichloroethane					120	38	
1,2-Dichloroethane			13				
2-Butanone							
2-Hexanone							

Notes:
1) No volatile organic compounds were detected in samples SW1-1, BW1-2, BW3-1, BW3-2, BW4-1 and BW4-2.
D - Sample diluted for this analyte.
E - Estimated result. Analyte concentration exceeded the instrument calibration range.
B - Analyte detected in the associated blank. Result not corrected.
J - Estimated result. Analyte detected at less than the sample quantitation limit.

* Raw data results for BW1-3, SW1-2, BW4-3 and SW106-3 were inconsistent with concentrations previously reported. These wells were subsequently resampled (Nov. 26 and 27, 1990) and samples were submitted to Ecotek Laboratory for analysis. The Ecotek results are indicated by the 'Resample' designation.

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MEDLEY FARM SITE RI
ANALYTICAL DATA SUMMARY
VOLATILE ORGANIC COMPOUNDS DETECTED
IN
GROUND WATER (ug/l) - See Notes

SAMPLE LOCATION	SW101	BW105			BW106	SW106	
SAMPLE I.D.	SW101-3	BW105-1X	BW105-1Z	BW105-3	BW106-1	*SW106-3	SW106-4
SAMPLE DATE	09-26-90	09-19-90	09-18-90	10-15-90	09-28-90	09-27-90	11-26-90
PHASE	PHASE II	PHASE II	PHASE II	PHASE II	PHASE II	PHASE II	PHASE II (Resample)
PARAMETER							
Acetone						160	5 BJ
Benzene		95		11			
Carbon tetrachloride							
Chloroform							
Chloromethane		110					
Methylene chloride							4 BJ
Tetrachloroethene							
Toluene						91	
Trichloroethene							
1,1,2,2-Tetrachloroethane							
1,1,1-Trichloroethane	7	90	80	9	5.2	9.3	
1,1,2-Trichloroethane							
1,1-Dichloroethene		27	39				
1,2-Dichloroethene (total)							
1,1-Dichloroethane							
1,2-Dichloroethane							
2-Butanone					13	170	
2-Hexanone						14	

Notes:
1) No volatile organic compounds were detected in samples SW1-1, BW1-2, BW3-1, BW3-2, BW4-1 and BW4-2.
D - Sample diluted for this analyte.
E - Estimated result. Analyte concentration exceeded the instrument calibration range.
B - Analyte detected in the associated blank. Result not corrected.
J - Estimated result. Analyte detected at less than the sample quantitation limit.

* Raw data results for BW1-3, SW1-2, BW4-3 and SW106-3 were inconsistent with concentrations previously reported. These wells were subsequently resampled (Nov. 26 and 27, 1990) and samples were submitted to Ecotek Laboratory for analysis. The Ecotek results are indicated by the 'Resample' designation.

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TABLE 5.7 (continued)   Page 4 of 4
MEDLEY FARM SITE RI
ANALYTICAL DATA SUMMARY
VOLATILE ORGANIC COMPOUNDS DETECTED
IN
GROUND WATER (ug/l) - See Notes

SAMPLE LOCATION	BW108	SW108	BW109
SAMPLE I.D.	BW108-3	SW108-3	BW109-3
SAMPLE DATE	10-02-90	09-25-90	10-15-90
PHASE	PHASE II		
PARAMETER			
Acetone			
Benzene			
Carbon tetrachloride			
Chloroform			6
Chloromethane		26	
Methylene chloride			
Tetrachloroethene	230	30	
Toluene			
Trichloroethene	380	45	
1,1,2,2-Tetrachloroethane			
1,1,1-Trichloroethane	15	13	6
1,1,2-Trichloroethane			
1,1-Dichloroethene	80	11	
1,2-Dichloroethene (total)	17		
1,1-Dichloroethane			
1,2-Dichloroethane	12		
2-Butanone			
2-Hexanone			

Notes:

1) No volatile organic compounds were detected in samples SW1-1, BW1-2, BW3-1, BW3-2, BW4-1 and BW4-2.

D - Sample diluted for this analyte.

E - Estimated result. Analyte concentration exceeded the instrument calibration range.

B - Analyte detected in the associated blank. Result not corrected.

J - Estimated result. Analyte detected at less than the sample quantitation limit.

* Raw data results for BW1-3, SW1-2, BW4-3 and SW106-3 were inconsistent with concentrations previously reported. These wells were subsequently resampled (Nov. 26 and 27, 1990) and samples were submitted to Ecotek Laboratory for analysis. The Ecotek results are indicated by the 'Resample' designation.

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APPENDIX B
GROUND-WATER MODELING CALCULATIONS
MEDLEY FARM SITE

Average aquifer thickness: 33 feet (transition zone + saprolite)

Hydraulic conductivity: 2.29 feet/day (saprolite)

Hydraulic gradient: 0.046 to 0.056 (water table)

Width of aquifer across which ground water must be withdrawn:

Option 1: 1150 feet

Option 2:   800 feet

Specific discharge:

Option 1: 1150 x 33 x 2.29 x 0.056 = 4,867 ft³/day = 25 gpm

1150 x 33 x 2.29 x 0.046 = 3,997 ft³/day = 21 gpm

Option 2:   800 x 33 x 2.29 x 0.056 = 3,386 ft³/day = 18 gpm

800 x 33 x 2.29 x 0.046 = 2,781 ft³/day = 14 gpm

A model presented in Walton (1987) was used to evaluate possible well pumping rates and spacings. The microcomputer program simulates radial two-dimensional flow toward a production well through a slice of an aquifer having a unit width and extending from the well to an outer boundary. Calculations were made for a water table aquifer system. Based on these calculations, it is estimated that a pumping rate of 2-3 gpm could be maintained with a well spacing on the order of 80-100 feet.

```
AQUIFER HORIZ. HYDR. COND. (GPD/SQ FT)=      6.90
AQUIFER VERT. HYDR. COND. (GPD/SQ FT)=      0.690
AQUIFER THICKNESS (FT)=   30.00
ARTESIAN AQUIFER STORATIVITY (DIM)= 1.0000D-02
WATER TABLE STORATIVITY (DIM)= 0.1000
PR⌐  T. WELL EFFECTIVE RADIUS (FT)= 0.600
TO⌐  ⌐ AQUIFER DEPTH (FT)=   60.00
BASE OF AQUIFER DEPTH (FT)=    90.00
INITIAL WATER LEVEL DEPTH (FT)=   60.00
INFINITE AQUIFER SYSTEM
```

3 10   0283

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COMPUTATION RESULTS:

PRODUCTION WELL DISCHARGE RATE (GPM)=    3.00

TIME-DRAWDOWN OR WATER LEVEL VALUES (FT)

                    SELECTED DISTANCES (FT)

TIME(MIN)      0.60       95.09      238.86      600.00     1507.13     3785.74

      0.14    60.05      60.00      60.00       60.00       60.00       60.00
      0.23    60.08      60.00      60.00       60.00       60.00       60.00
      0.36    60.12      60.00      60.00       60.00       60.00       60.00
      0.57    60.19      60.00      60.00       60.00       60.00       60.00
      0.91    60.30      60.00      60.00       60.00       60.00       60.00
      1.44    60.47      60.00      60.00       60.00       60.00       60.00
      2.28    60.73      60.00      60.00       60.00       60.00       60.00
      3.62    61.11      60.00      60.00       60.00       60.00       60.00
      5.73    61.66      60.00      60.00       60.00       60.00       60.00
      9.09    62.44      60.00      60.00       60.00       60.00       60.00
      .40     63.51      60.00      60.00       60.00       60.00       60.00
      .82     64.89      60.00      60.00       60.00       60.00       60.00
     36.17    66.59      60.00      60.00       60.00       60.00       60.00
     57.33    68.57      60.00      60.00       60.00       60.00       60.00
     90.86    70.74      60.00      60.00       60.00       60.00       60.00
    144.00    73.05      60.00      60.00       60.00       60.00       60.00
    228.22    75.44      60.01      60.00       60.00       60.00       60.00
    361.71    77.93      60.02      60.00       60.00       60.00       60.00
    573.27    80.66      60.06      60.00       60.00       60.00       60.00
    908.58    83.95      60.16      60.00       60.00       60.00       60.00
EXCESSIVE DRAWDOWN

TIME AFTER PUMPING STARTED(MIN)= 1440.00

DISTANCE-DRAWDOWN OR WATER LEVEL VALUES AT END OF PUMPING PERIOD

NODE   RADIUS(FT)    DRAWDOWN OR WATER LEVEL (FT)
  NO
  2      0.60           83.95
  3      0.95           78.83
  4      1.51           75.37
  5      2.39           72.58
  6      3.79           70.19
  7      6.00           68.07
  8      9.51           66.16
  9     15.07           64.42
 10     23.89           62.98
 11     37.86           61.59
 12     60.00           60.65
 13     95.09           60.16
 14    150.71           60.02
```

B.2   Contaminant Transport Calculations for Risk Assessment

Potential future concentrations of contaminants detected in ground water at the Medley Farm Site were calculated using a two-dimensional analytical contaminant transport model titled "CONMIG" (Walton, 1988). The model assumes one-dimensional ground-water flow. Contaminant attenuation is allowed through longitudinal and transverse dispersion and adsorption of contaminants onto the aquifer matrix.

Parameter values used in the model include:

Aquifer actual porosity: .3

Aquifer effective porosity: .2

Aquifer thickness: 33 feet

Longitudinal dispersivity: 30 feet

Transverse dispersivity: 6 feet

Seepage velocity: 0.156, based on a hydraulic gradient in the bedrock of 0.42, an average hydraulic conductivity in the bedrock of 0.741 feet per day, and a porosity of 20 percent.

Bulk density of aquifer: 1.86 g/cu cm

Organic carbon content: .04 percent, based on Total Organic Carbon values reported for PZ101 (469 mg/kg), SW101 (447 mg/kg), SW102 (484 mg/kg), and SW109 (203 mg/kg).

Source volume: 69,000 gallons (slug)

Source concentration: Maximum concentration reported in the RI for each compound.

The aquifer distribution coefficient (Kd) was calculated for each contaminant based on the organic carbon distribution coefficient (Koc) for the compound and the organic carbon content of the aquifer. Koc values and calculated Kd values are presented in Table B1.

Contaminant concentrations were calculated for a point at the boundary of the Medley Farm property, at a distance of 1,000 feet hydraulically downgradient from the source area. This is considered to represent the closest point at which a water supply well could be installed off the Medley Farm Site property yet within the contaminant migration pathway. Calculations were completed for the time period of 10 to 70 years from present, with discrete calculations made for 10 year intervals.

Resultant concentrations are presented in Table B2. The representative concentration used in the Risk Assessment is the arithmetic average of the seven discrete concentrations calculated at ten-year intervals.

TABLE B1

CALCULATED Kd VALUES AND MAXIMUM CONCENTRATION

USED IN CONTAMINANT TRANSPORT CALCULATIONS

Compound	Koc (ml/g)	Kd (ml/g)	Maximum Concentration (ug/l)
1,1,1-trichloroethane	178	0.071	3400
1,1-dichloroethene	65	0.026	2200
trichloroethene	126	0.050	720
1,2-dichloroethane	32	0.013	290
tetrachloroethene	363	0.145	230
1,1-dichloroethane	32	0.013	120
methylene chloride	.011	0.000044	110
1,2-dichloroethene	59	0.024	31
1,1,2-trichloroethane	56	0.022	13
chloroform	44	0.0176	10

TABLE B2

CALCULATED POTENTIAL GROUND WATER CONCENTRATIONS AT PROPERTY BOUNDARY

				Time (years)				
Compound	10	20	30	40	50	60	70	70-Year Average
1,1,1-trichloroethane	0.00	18.34	16.74	1.37	0.04	0.00	0.00	5.21
1,1-dichloroethene	0.22	18.53	2.88	0.00	0.00	0.00	0.00	3.09
trichloroethene	0.00	5.54	2.11	0.11	0.00	0.00	0.00	1.11
1,2-dichloroethane	0.10	2.22	0.22	0.01	0.00	0.00	0.00	0.36
tetrachloroethene	0.00	0.05	1.77	0.94	0.09	0.00	0.00	0.41
1,2-dichloroethene	0.00	0.26	0.04	0.00	0.00	0.00	0.00	0.04
1,1,2-trichloroethane	0.00	0.11	0.01	0.00	0.00	0.00	0.00	0.02
chloroform	0.00	0.085	0.01	0.00	0.00	0.00	0.00	0.01
methylene chloride	0.11	0.70	0.05	0.00	0.00	0.00	0.00	0.12

DATA BASE:

Number of simulation periods for which contaminant
concentration distribution is to be calculated 10

Simulation period number= 1
Simulation period duration in days= 3650.00
Simulation period number= 2
Simulation period duration in days= 7300.00
Simulation period number= 3
Simulation period duration in days=10950.00
Simulation period number= 4
Simulation period duration in days=14600.00
Simulation period number= 5
Simulation period duration in days=18250.00
Simulation period number= 6
Simulation period duration in days=21900.00
Simulation period number= 7
Simulation period duration in days=25550.00
Simulation period number= 8
Simulation period duration in days=   30.00
Simulation period number= 9
Simulation period duration in days= 365.00
Simulation period number= 10
Simulation period duration in days=   90.00

Number of grid columns= 15
Number of grid rows= 7
Grid spacing in ft=   100.00
X-coordinate of upper-left grid node in ft=   100.00
Y-coordinate of upper-left grid node in ft=   100.00
Aquifer actual porosity as a decimal= 0.300
Aquifer effective porosity as a decimal= 0.200
Simulation period number= 1
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 2
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 3
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 4
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 5
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 6

Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 7
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 8
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 9
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 10
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 1
Point source number 1
X-coordinate of point source in ft=   0.00
Y-coordinate of point source in ft=   400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 3400.000
Time after slug contaminant injection in days= 3650.00
Simulation period number= 2
Point source number 1
X-coordinate of point source in ft=   0.00
Y-coordinate of point source in ft=   400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 3400.000
Time after slug contaminant injection in days= 7300.00
Simulation period number= 3
Point source number 1
X-coordinate of point source in ft=   0.00
Y-coordinate of point source in ft=   400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 3400.000
Time after slug contaminant injection in days=10950.00
Simulation period number= 4
Point source number 1
X-coordinate of point source in ft=   0.00
Y-coordinate of point source in ft=   400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 3400.000
Time after slug contaminant injection in days=14600.00
Simulation period number= 5
Point source number 1
X-coordinate of point source in ft=   0.00
Y-coordinate of point source in ft=   400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 3400.000
Time after slug contaminant injection in days=18250.00
Simulation period number= 6
Point source number 1

X-coordinate of point source in ft= 400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 3400.000
Time after slug contaminant injection in days=21900.00
Simulation period number= 7
Point source number 1
X-coordinate of point source in ft= 0.00
Y-coordinate of point source in ft= 400.00

Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 3400.000
Time after slug contaminant injection in days=25550.00
Simulation period number= 8
Point source number 1
X-coordinate of point source in ft= 0.00
Y-coordinate of point source in ft= 400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 3400.000
Time after slug contaminant injection in days= 3.00
Simulation period number= 9
Point source number 1
X-coordinate of point source in ft= 0.00
Y-coordinate of point source in ft= 400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 3400.000
Time after slug contaminant injection in days= 30.00
Simulation period number= 10
Point source number 1
X-coordinate of point source in ft= 0.00
Y-coordinate of point source in ft= 400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 3400.000
Time after slug contaminant injection in days= 10.00
Bulk density of dry aquifer skeleton in g/cu cm= 1.86
Aqu distribution coefficient in ml/g= .071
Numb of monitor wells for which time-.
concentration tables are desired= 1
Monitor well number= 1
I-coordinate of monitor well= 10
J-coordinate of monitor well= 4

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS: 3650.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

I-ROW				I-COLUMN				
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.01	0.05	0.12	0.16	0.12	0.05	0.01	0.00
3	1.11	4.91	11.86	15.62	11.21	4.38	0.93	0.11
4	5.05	22.38	54.10	71.25	51.14	20.00	1.26	0.19
5	1.11	4.91	11.86	15.62	11.21	4.38	0.93	0.11
6	0.01	0.05	0.12	0.16	0.12	0.05	0.01	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

I-ROW				I-COLUMN			
	9	10	11	12	13	14	15	16
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
3	0.01	0.00	0.00	0.00	0.00	0.00	0.00	
4	0.03	0.00	0.00	0.00	0.00	0.00	0.00	

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS: 7300.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW				I-COLUMN			
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.01	0.02	0.03	0.04
2	0.00	0.01	0.04	0.17	0.47	0.99	1.51	1.71
3	0.01	0.08	0.43	1.64	4.63	9.61	14.73	16.67
4	0.03	0.18	0.92	3.51	9.88	20.53	31.46	35.60
5	0.01	0.08	0.43	1.64	4.63	9.61	14.73	16.67
6	0.00	0.01	0.04	0.17	0.47	0.99	1.51	1.71
7	0.00	0.00	0.00	0.00	0.01	0.02	0.03	0.04

J-ROW				I-COLUMN			
	9	10	11	12	13	14	15	16
1	0.03	0.02	0.01	0.00	0.00	0.00	0.00	
2	1.43	0.88	0.40	0.13	0.03	0.01	0.00	
3	13.92	8.59	3.91	1.31	0.33	0.06	0.01	
4	29.74	18.34	8.35	2.80	0.70	0.13	0.02	
5	13.92	8.59	3.91	1.31	0.33	0.06	0.01	
6	1.43	0.88	0.40	0.13	0.03	0.01	0.00	
7	0.03	0.02	0.01	0.00	0.00	0.00	0.00	

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS:10950.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW				I-COLUMN			
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.06
2	0.00	0.00	0.00	0.01	0.03	0.10	0.29	0.70
3	0.00	0.00	0.01	0.03	0.12	0.44	1.31	3.17
4	0.00	0.00	0.01	0.05	0.20	0.74	2.18	5.26
5	0.00	0.00	0.01	0.03	0.12	0.44	1.31	3.17
6	0.00	0.00	0.00	0.01	0.03	0.10	0.29	0.70
7	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.06

J-ROW				I-COLUMN			
	9	10	11	12	13	14	15	16
1	0.11	0.18	0.23	0.25	0.22	0.16	0.09	
2	1.37	2.21	2.91	3.13	2.75	1.98	1.16	
3	6.26	10.09	13.29	14.30	12.57	9.02	5.29	
4	10.38	16.71	22.02	24.12	20.81	14.95	8.77	
5	6.26	10.09	13.29	14.30	12.57	9.02	5.29	
6	1.37	2.21	2.91	3.13	2.75	1.98	1.16	
7	0.11	0.18	0.23	0.25	0.22	0.16	0.09	

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS: 7300.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW	I-COLUMN							
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
2	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.04
3	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.12
4	0.00	0.00	0.00	0.00	0.00	0.01	0.05	0.17
5	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.12
6	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.04
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01

J-ROW	I-COLUMN							
	9	10	11	12	13	14	15	16
1	0.02	0.05	0.10	0.19	0.32	0.46	0.56	
2	0.12	0.30	0.67	1.30	2.14	3.04	3.72	
3	0.36	0.94	2.10	4.04	6.69	9.50	11.60	
4	0.53	1.37	3.07	5.91	9.77	13.88	16.95	
5	0.36	0.94	2.10	4.04	6.69	9.50	11.60	
6	0.12	0.30	0.67	1.30	2.11	3.04	3.72	
7	0.02	0.05	0.10	0.19	0.32	0.46	0.56	

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS:18250.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW	I-COLUMN							
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

J-ROW	I-COLUMN							
	9	10	11	12	13	14	15	16
1	0.00	0.00	0.01	0.02	0.06	0.12	0.23	
2	0.00	0.01	0.01	0.11	0.29	0.56	1.06	
3	0.01	0.03	0.10	0.27	0.65	1.40	2.65	
4	0.01	0.04	0.13	0.37	0.88	1.89	3.59	
5	0.01	0.03	0.10	0.27	0.65	1.40	2.65	
6	0.00	0.01	0.04	0.11	0.26	0.56	1.06	
7	0.00	0.00	0.01	0.02	0.06	0.12	0.23	

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS:21900.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW	I-COLUMN							
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

6

3 10 0293

	9	10	11	12	13	14	15	16
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

J-ROW

I-COLUMN

J-ROW	9	10	11	12	13	14	15	16
1	0.00	0.00	0.00	0.00	0.00	0.01	0.03	
2	0.00	0.00	0.00	0.00	0.01	0.01	0.09	
3	0.00	0.00	0.00	0.01	0.02	0.08	0.20	
4	0.00	0.00	0.00	0.01	0.04	0.10	0.25	
5	0.00	0.00	0.00	0.01	0.03	0.08	0.20	
6	0.00	0.00	0.00	0.00	0.01	0.04	0.09	
7	0.00	0.00	0.00	0.00	0.00	0.01	0.03	

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS:25550.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

I-COLUMN

J-ROW	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

I-COLUMN

J-ROW	9	10	11	12	13	14	15	16
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
3	0.00	0.00	0.00	0.00	0.00	0.00	0.01	
4	0.00	0.00	0.00	0.00	0.00	0.00	0.01	
5	0.00	0.00	0.00	0.00	0.00	0.00	0.01	
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS: 30.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

I-COLUMN

J-ROW	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

J-ROW

1	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS: 365.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

I-ROW				I-COLUMN			
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

I-ROW				I-COLUMN			
	9	10	11	12	13	14	15	16
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS: 90.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

I-ROW				I-COLUMN			
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

I-ROW				I-COLUMN			
	9	10	11	12	13	14	15	16
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00

MONITOR WELL COMPUTATION RESULTS:

TIME-CONCENTRATION TABLE

MONITOR WELL NUMBER: 1

TIME(DAYS)	CONCENTRATION(MG/L)
3650.000	0.00
7300.000	18.34
10950.000	16.74
14600.000	1.37
18250.000	0.04
21900.000	0.00
25550.000	0.00
30.000	0.00
365.000	0.00
90.000	0.00

3 10   0295

DATA BASE:

Number of simulation periods for which contaminant
concentration distribution is to be calculated 7

Simulation period number= 1
Simulation period duration in days= 3650.00
Simulation period number= 2
Simulation period duration in days= 7300.00
Simulation period number= 3
Simulation period duration in days=10950.00
Simulation period number= 4
Simulation period duration in days=14600.00
Simulation period number= 5
Simulation period duration in days=18250.00
Simulation period number= 6
Simulation period duration in days=21900.00
Simulation period number= 7
Simulation period duration in days=25550.00
Number of grid columns= 15
Number of grid rows= 7
Grid spacing in ft=   100.00
X-coordinate of upper-left grid node in ft=   100.00
Y-coordinate of upper-left grid node in ft=   100.00
Aquifer actual porosity as a decimal= 0.300
Aquifer effective porosity as a decimal= 0.200
Simulation period number= 1
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 2
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 3
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 4
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 5
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 6
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 7
Aquifer thickness in ft= 33.00

1,1-PCE   1

Note: all concentrations
in µg/L, not mg/L.

3 10   0296

Aquifer transverse dispersivity in ft= 0.00
Seepage velocity in ft/day= 0.16
Number of point sources= 1
Simulation period number= 1
Point source number 1
X-coordinate of point source in ft= 0.00
Y-coordinate of point source in ft= 400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 2200.000
Time after slug contaminant injection in days= 3650.00
Simulation period number= 2
Point source number 1
X-coordinate of point source in ft= 0.00
Y-coordinate of point source in ft= 400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 2200.000
Time after slug contaminant injection in days= 7300.00
Simulation period number= 3
Point source number 1
X-coordinate of point source in ft= 0.00
Y-coordinate of point source in ft= 400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 2200.000
Time after slug contaminant injection in days=10950.00
Simulation period number= 4
Point source number 1
X-coordinate of point source in ft= 0.00
Y-coordinate of point source in ft= 400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 2200.000
Time after slug contaminant injection in days=14600.00
Simulation period number= 5
Point source number 1
X-coordinate of point source in ft= 0.00
Y-coordinate of point source in ft= 400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 2200.000
Time after slug contaminant injection in days=18250.00
Simulation period number= 6
Point source number 1
X-coordinate of point source in ft= 0.00
Y-coordinate of point source in ft= 400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 2200.000
Time after slug contaminant injection in days=21900.00
Simulation period number= 7
Point source number 1
X-coordinate of point source in ft= 0.00
Y-coordinate of point source in ft= 400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 2200.000
Time after slug contaminant injection in days=25550.00
Bulk density of dry aquifer skeleton in g/cu cm= 1.86
Aquifer distribution coefficient in ml/g= .026
Number of monitor wells for which time-
concentration tables are desired= 1
Monitor well number= 1
I-coordinate of monitor well= 10
J-coordinate of monitor well= 1

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS: 3650.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW	I-COLUMN							
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
2	0.04	0.14	0.35	0.61	0.72	0.57	0.30	0.11
3	0.69	2.63	6.78	11.80	13.84	10.94	5.83	2.09
4	1.84	7.05	18.20	31.66	37.13	29.34	15.63	5.61
5	0.69	2.63	6.78	11.80	13.84	10.94	5.83	2.09
6	0.04	0.14	0.35	0.61	0.72	0.57	0.30	0.11
7	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00

J-ROW	I-COLUMN							
	9	10	11	12	13	14	15	16
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
2	0.03	0.00	0.00	0.00	0.00	0.00	0.00	
3	0.51	0.08	0.01	0.00	0.00	0.00	0.00	
4	1.36	0.22	0.02	0.00	0.00	0.00	0.00	
5	0.51	0.08	0.01	0.00	0.00	0.00	0.00	
6	0.03	0.00	0.00	0.00	0.00	0.00	0.00	
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS: 7300.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW	I-COLUMN							
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.01	0.02	0.05	0.10	0.16
2	0.00	0.01	0.03	0.09	0.26	0.62	1.19	1.87
3	0.01	0.03	0.12	0.41	1.16	2.72	5.22	8.23
4	0.01	0.05	0.19	0.67	1.90	4.45	8.55	13.48
5	0.01	0.03	0.12	0.41	1.16	2.72	5.22	8.23
6	0.00	0.01	0.03	0.09	0.26	0.62	1.19	1.87
7	0.00	0.00	0.00	0.01	0.02	0.05	0.10	0.16

J-ROW	I-COLUMN							
	9	10	11	12	13	14	15	16
1	0.21	0.22	0.19	0.14	0.08	0.04	0.02	
2	2.42	2.58	2.25	1.61	0.95	0.46	0.18	
3	10.65	11.31	9.87	7.07	4.15	2.00	0.79	
4	17.44	18.53	16.16	11.57	6.80	3.28	1.30	
5	10.65	11.31	9.87	7.07	4.15	2.00	0.79	
6	2.42	2.58	2.25	1.61	0.95	0.46	0.18	
7	0.21	0.22	0.19	0.14	0.08	0.04	0.02	

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS:10950.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW	I-COLUMN							
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03
2	0.00	0.00	0.00	0.00	0.01	0.02	0.07	0.17
3	0.00							

J-ROW							
5	0.00	0.00	0.00	0.00	0.02	0.06	0.16	0.46
6	0.00	0.00	0.00	0.00	0.01	0.02	0.07	0.17
7	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03

J-ROW				I-COLUMN			
	9	10	11	12	13	14	15	16
1	0.08	0.15	0.26	0.40	0.53	0.62	0.64	
2	0.39	0.77	1.34	2.05	2.74	3.22	3.31	
3	1.04	2.07	3.61	5.50	7.36	8.63	8.88	
4	1.45	2.88	5.01	7.65	10.23	11.99	12.33	
5	1.04	2.07	3.61	5.50	7.36	8.63	8.88	
6	0.39	0.77	1.34	2.05	2.74	3.22	3.31	
7	0.08	0.15	0.26	0.40	0.53	0.62	0.64	

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NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS:14600.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW				I-COLUMN			
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

J-ROW				I-COLUMN			
	9	10	11	12	13	14	15	16
1	0.00	0.01	0.03	0.06	0.12	0.21	0.35	
2	0.01	0.04	0.09	0.20	0.40	0.73	1.21	
3	0.03	0.08	0.19	0.42	0.84	1.53	2.54	
4	0.04	0.10	0.24	0.53	1.07	1.96	3.25	
5	0.03	0.08	0.19	0.42	0.84	1.53	2.54	
6	0.01	0.04	0.09	0.20	0.40	0.73	1.21	
7	0.00	0.01	0.03	0.06	0.12	0.21	0.35	

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS:18250.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW				I-COLUMN			
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00

J-ROW				I-COLUMN			
	9	10	11	12	13	14	15	16

1						
2	0.00	0.00	0.00	0.01	0.02	0.04	0.09
3	0.00	0.00	0.00	0.01	0.03	0.08	0.17
4	0.00	0.00	0.01	0.02	0.04	0.09	0.21
5	0.00	0.00	0.00	0.01	0.03	0.08	0.17
6	0.00	0.00	0.00	0.01	0.02	0.04	0.09
7	0.00	0.00	0.00	0.00	0.01	0.02	0.04

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS:21900.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW				I-COLUMN				
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

J-ROW				I-COLUMN				
	9	10	11	12	13	14	15	16
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
3	0.00	0.00	0.00	0.00	0.00	0.00	0.01	
4	0.00	0.00	0.00	0.00	0.00	0.00	0.01	
5	0.00	0.00	0.00	0.00	0.00	0.00	0.01	
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS:25550.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW				I-COLUMN				
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

J-ROW				I-COLUMN				
	9	10	11	12	13	14	15	16
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

TIME-CONCENTRATION TABLE

MONITOR WELL NUMBER: 1

TIME(DAYS)	CONCENTRATION(MG/L)
3650.000	0.22
7300.000	18.53
10950.000	2.88
14600.000	0.10
18250.000	0.00
21900.000	0.00
25550.000	0.00

3 10 0301

DATA BASE:

Number of simulation periods for which contaminant
concentration distribution is to be calculated 7

Simulation period number= 1
Simulation period duration in days= 3650.00
Simulation period number= 2
Simulation period duration in days= 7300.00
Simulation period number= 3
Simulation period duration in days=10950.00
Simulation period number= 4
Simulation period duration in days=14600.00
Simulation period number= 5
Simulation period duration in days=18250.00
Simulation period number= 6
Simulation period duration in days=21900.00
Simulation period number= 7
Simulation period duration in days=25550.00
Number of grid columns= 15
Number of grid rows= 7
Grid spacing in ft=   100.00
X-coordinate of upper-left grid node in ft=   100.00
Y-coordinate of upper-left grid node in ft=   100.00
Aquifer actual porosity as a decimal= 0.300
Aquifer effective porosity as a decimal= 0.200
Simulation period number= 1
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 2
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 3
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 4
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 5
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 6
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 7
Aquifer thickness in ft= 33.00

Aquifer longitudinal dispersivity in ft= 60.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day= 0.16
Number of point sources= 1
Simulation period number= 1
Point source number 1
X-coordinate of point source in ft= 0.00
Y-coordinate of point source in ft= 400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 720.000
Time after slug contaminant injection in days= 3650.00
Simulation period number= 2
Point source number 1
X-coordinate of point source in ft= 0.00
Y-coordinate of point source in ft= 400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 720.000
Time after slug contaminant injection in days= 7300.00
Simulation period number= 3
Point source number 1
X-coordinate of point source in ft= 0.00
Y-coordinate of point source in ft= 400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 720.000
Time after slug contaminant injection in days=10950.00
Simulation period number= 4
Point source number 1
X-coordinate of point source in ft= 0.00
Y-coordinate of point source in ft= 400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 720.000
Time after slug contaminant injection in days=14600.00
Simulation period number= 5
Point source number 1
X-coordinate of point source in ft= 0.00
Y-coordinate of point source in ft= 400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 720.000
Time after slug contaminant injection in days=18250.00
Simulation period number= 6
Point source number 1
X-coordinate of point source in ft= 0.00
Y-coordinate of point source in ft= 400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 720.000
Time after slug contaminant injection in days=21900.00
Simulation period number= 7
Point source number 1
X-coordinate of point source in ft= 0.00
Y-coordinate of point source in ft= 400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 720.000
Time after slug contaminant injection in days=25550.00
Bulk density of dry aquifer skeleton in g/cu cm= 1.86
Aquifer distribution coefficient in ml/g= .05
Number of monitor wells for which time-
concentration tables are desired= 1
Monitor well number= 1
X-coordinate of monitor well= 10
Y-coordinate of monitor well= 1

TOTAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS: 3650.00

J-ROW				I-COLUMN				
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.01	0.02	0.06	0.09	0.08	0.05	0.02	0.00
3	0.23	0.98	2.48	3.80	3.51	1.97	0.67	0.14
4	0.82	3.44	8.71	13.33	12.34	6.91	2.34	0.48
5	0.23	0.98	2.48	3.80	3.51	1.97	0.67	0.14
6	0.01	0.02	0.06	0.09	0.08	0.05	0.02	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

J-ROW				I-COLUMN				
	9	10	11	12	13	14	15	16
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
3	0.02	0.00	0.00	0.00	0.00	0.00	0.00	
4	0.06	0.00	0.00	0.00	0.00	0.00	0.00	
5	0.02	0.00	0.00	0.00	0.00	0.00	0.00	
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

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NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS: 7300.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW				I-COLUMN				
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.02
2	0.00	0.00	0.01	0.04	0.10	0.22	0.39	0.52
3	0.00	0.01	0.06	0.23	0.66	1.47	2.56	3.45
4	0.00	0.02	0.12	0.43	1.24	2.76	4.79	6.46
5	0.00	0.01	0.06	0.23	0.66	1.47	2.56	3.45
6	0.00	0.00	0.01	0.04	0.10	0.22	0.39	0.52
7	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.02

J-ROW				I-COLUMN				
	9	10	11	12	13	14	15	16
1	0.02	0.02	0.01	0.01	0.00	0.00	0.00	
2	0.55	0.45	0.29	0.14	0.05	0.02	0.00	
3	3.62	2.96	1.88	0.93	0.36	0.11	0.02	
4	6.79	5.54	3.52	1.74	0.67	0.20	0.05	
5	3.62	2.96	1.88	0.93	0.36	0.11	0.02	
6	0.55	0.45	0.29	0.14	0.05	0.02	0.00	
7	0.02	0.02	0.01	0.01	0.00	0.00	0.00	

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS:10950.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW				I-COLUMN				
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
2	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.10

J-ROW				I-COLUMN				
	9	10	11	12	13	14	15	16
1	0.03	0.05	0.07	0.10	0.11	0.10	0.08	
2	0.22	0.40	0.61	0.78	0.86	0.79	0.62	
3	0.77	1.39	2.13	2.75	3.01	2.79	2.18	
4	1.17	2.11	3.23	4.18	4.58	4.24	3.32	
5	0.77	1.39	2.13	2.75	3.01	2.79	2.18	
6	0.22	0.40	0.61	0.78	0.86	0.79	0.62	
7	0.03	0.05	0.07	0.10	0.11	0.10	0.08	

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS:14600.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW				I-COLUMN				
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

J-ROW				I-COLUMN				
	9	10	11	12	13	14	15	16
1	0.00	0.01	0.02	0.03	0.06	0.10	0.14	
2	0.01	0.03	0.08	0.16	0.29	0.48	0.68	
3	0.03	0.08	0.19	0.41	0.75	1.22	1.75	
4	0.04	0.11	0.27	0.56	1.03	1.67	2.40	
5	0.03	0.08	0.19	0.41	0.75	1.22	1.75	
6	0.01	0.03	0.08	0.16	0.29	0.48	0.68	
7	0.00	0.01	0.02	0.03	0.06	0.10	0.14	

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS:18250.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW				I-COLUMN				
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

J-ROW				I-COLUMN				
	9	10	11	12	13	14	15	16

1	0.00	0.00	0.00	0.00	0.01	0.01	0.03
2	0.00	0.00	0.00	0.01	0.02	0.05	0.10
3	0.00	0.00	0.01	0.02	0.05	0.11	0.22
4	0.00	0.00	0.01	0.02	0.06	0.14	0.28
5	0.00	0.00	0.01	0.02	0.05	0.11	0.22
6	0.00	0.00	0.00	0.01	0.02	0.05	0.10
7	0.00	0.00	0.00	0.00	0.01	0.01	0.03

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS:21900.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW				I-COLUMN				
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

J-ROW				I-COLUMN				
	9	10	11	12	13	14	15	16
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
2	0.00	0.00	0.00	0.00	0.00	0.00	0.01	
3	0.00	0.00	0.00	0.00	0.00	0.00	0.01	
4	0.00	0.00	0.00	0.00	0.00	0.01	0.01	
5	0.00	0.00	0.00	0.00	0.00	0.00	0.01	
6	0.00	0.00	0.00	0.00	0.00	0.00	0.01	
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS:25550.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW				I-COLUMN				
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

J-ROW				I-COLUMN				
	9	10	11	12	13	14	15	16
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

MONITOR WELL COMPUTATION RESULTS:

TIME-CONCENTRATION TABLE

MONITOR WELL NUMBER: 1

TIME(DAYS)	CONCENTRATION(MG/L)
3650.000	0.00
7300.000	5.54
10950.000	2.11
14600.000	0.11
18250.000	0.00
21900.000	0.00
25550.000	0.00

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DATA BASE:

Number of simulation periods for which contaminant
concentration distribution is to be calculated 7

Simulation period number= 1
Simulation period duration in days= 3650.00
Simulation period number= 2
Simulation period duration in days= 7300.00
Simulation period number= 3
Simulation period duration in days=10950.00
Simulation period number= 4
Simulation period duration in days=14600.00
Simulation period number= 5
Simulation period duration in days=18250.00
Simulation period number= 6
Simulation period duration in days=21900.00
Simulation period number= 7
Simulation period duration in days=25550.00
Number of grid columns= 15
Number of grid rows= 7
Grid spacing in ft=   100.00
X-coordinate of upper-left grid node in ft=   100.00
Y-coordinate of upper-left grid node in ft=   100.00
Aquifer actual porosity as a decimal= 0.300
Aquifer effective porosity as a decimal= 0.200
Simulation period number= 1
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 2
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 3
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 4
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 5
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 6
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 7
Aquifer thickness in ft= 33.00

PCE

Note: All concentrations
in μg/L, not mg/L.

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Aquifer longitudinal dispersivity in ft= ....
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 1
Point source number 1
X-coordinate of point source in ft=   0.00
Y-coordinate of point source in ft=   400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 230.000
Time after slug contaminant injection in days= 3650.00
Simulation period number= 2
Point source number 1
X-coordinate of point source in ft=   0.00
Y-coordinate of point source in ft=   400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 230.000
Time after slug contaminant injection in days= 7300.00
Simulation period number= 3
Point source number 1
X-coordinate of point source in ft=   0.00
Y-coordinate of point source in ft=   400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 230.000
Time after slug contaminant injection in days=10950.00
Simulation period number= 4
Point source number 1
X-coordinate of point source in ft=   0.00
Y-coordinate of point source in ft=   400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 230.000
Time after slug contaminant injection in days=14600.00
Simulation period number= 5
Point source number 1
X-coordinate of point source in ft=   0.00
Y-coordinate of point source in ft=   400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 230.000
Time after slug contaminant injection in days=18250.00
Simulation period number= 6
Point source number 1
X-coordinate of point source in ft=   0.00
Y-coordinate of point source in ft=   400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 230.000
Time after slug contaminant injection in days=21900.00
Simulation period number= 7
Point source number 1
X-coordinate of point source in ft=   0.00
Y-coordinate of point source in ft=   400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 230.000
Time after slug contaminant injection in days=25550.00
Bulk density of dry aquifer skeleton in g/cu cm=   1.86
Aquifer distribution coefficient in ml/g= .145
Number of monitor wells for which time-
concentration tables are desired= 1
Monitor well number= 1
I-coordinate of monitor well= 10
J-coordinate of monitor well= 4

FINAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS: 3650.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW	I-COLUMN							
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.06	0.27	0.45	0.27	0.05	0.00	0.00	0.00
4	0.77	3.76	6.36	3.75	0.77	0.05	0.00	0.00
5	0.06	0.27	0.45	0.27	0.05	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

J-ROW	I-COLUMN							
	9	10	11	12	13	14	15	16
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS: 7300.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW	I-COLUMN							
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.01	0.01	0.02	0.01	0.01
3	0.00	0.01	0.08	0.30	0.65	0.85	0.65	0.29
4	0.00	0.05	0.30	1.11	2.45	3.18	2.44	1.10
5	0.00	0.01	0.08	0.30	0.65	0.85	0.65	0.29
6	0.00	0.00	0.00	0.01	0.01	0.02	0.01	0.01
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

J-ROW	I-COLUMN							
	9	10	11	12	13	14	15	16
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
3	0.08	0.01	0.00	0.00	0.00	0.00	0.00	
4	0.29	0.05	0.00	0.00	0.00	0.00	0.00	
5	0.08	0.01	0.00	0.00	0.00	0.00	0.00	
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS:10950.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW	I-COLUMN							
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.05

5	0.00	0.00	0.00	0.01	0.05	0.18	0.44	0.73
6	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.05
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

J-ROW				I-COLUMN				
	9	10	11	12	13	14	15	16
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
2	0.06	0.05	0.03	0.01	0.00	0.00	0.00	
3	0.88	0.74	0.43	0.18	0.05	0.01	0.00	
4	2.12	1.77	1.05	0.43	0.13	0.03	0.00	
5	0.88	0.74	0.43	0.18	0.05	0.01	0.00	
6	0.06	0.05	0.03	0.01	0.00	0.00	0.00	
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

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NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS:14600.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW				I-COLUMN				
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
3	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.10
4	0.00	0.00	0.00	0.00	0.00	0.01	0.06	0.19
5	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.10
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

J-ROW				I-COLUMN				
	9	10	11	12	13	14	15	16
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
2	0.03	0.07	0.10	0.11	0.10	0.07	0.03	
3	0.25	0.49	0.72	0.82	0.72	0.48	0.25	
4	0.49	0.94	1.40	1.59	1.39	0.93	0.48	
5	0.25	0.49	0.72	0.82	0.72	0.48	0.25	
6	0.03	0.07	0.10	0.11	0.10	0.07	0.03	
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS:18250.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW				I-COLUMN				
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

J-ROW				I-COLUMN				
	9	10	11	12	13	14	15	16

1	0.00	0.00	0.00	0.00	0.01	0.01	0.01
2	0.00	0.01	0.03	0.06	0.10	0.14	0.15
3	0.02	0.05	0.14	0.29	0.49	0.68	0.75
4	0.03	0.09	0.24	0.49	0.84	1.15	1.27
5	0.02	0.05	0.14	0.29	0.49	0.68	0.75
6	0.00	0.01	0.03	0.06	0.10	0.14	0.15
7	0.00	0.00	0.00	0.00	0.01	0.01	0.01

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS:21900.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW				I-COLUMN				
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

J-ROW				I-COLUMN				
	9	10	11	12	13	14	15	16
1	0.00	0.00	0.00	0.00	0.00	0.00	0.01	
2	0.00	0.00	0.00	0.01	0.02	0.04	0.08	
3	0.00	0.00	0.01	0.03	0.08	0.17	0.31	
4	0.00	0.00	0.01	0.05	0.12	0.26	0.48	
5	0.00	0.00	0.01	0.03	0.08	0.17	0.31	
6	0.00	0.00	0.00	0.01	0.02	0.04	0.08	
7	0.00	0.00	0.00	0.00	0.00	0.00	0.01	

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS:25550.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW				I-COLUMN				
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

J-ROW				I-COLUMN				
	9	10	11	12	13	14	15	16
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
2	0.00	0.00	0.00	0.00	0.00	0.01	0.01	
3	0.00	0.00	0.00	0.00	0.01	0.02	0.04	
4	0.00	0.00	0.00	0.00	0.01	0.02	0.06	
5	0.00	0.00	0.00	0.00	0.01	0.02	0.04	
6	0.00	0.00	0.00	0.00	0.00	0.01	0.01	
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

MONITOR WELL COMPUTATION RESULTS:

TIME-CONCENTRATION TABLE

MONITOR WELL NUMBER: 1

TIME(DAYS)	CONCENTRATION(MG/L)
3650.000	0.00
7300.000	0.05
10950.000	1.77
14600.000	0.94
18250.000	0.09
21900.000	0.00
25550.000	0.00

3 10   0313

DATA BASE:

Number of simulation periods for which contaminant
concentration distribution is to be calculated 7

Simulation period number= 1
Simulation period duration in days= 3650.00
Simulation period number= 2
Simulation period duration in days= 7300.00
Simulation period number= 3
Simulation period duration in days=10950.00
Simulation period number= 4
Simulation period duration in days=14600.00
Simulation period number= 5
Simulation period duration in days=18250.00
Simulation period number= 6
Simulation period duration in days=21900.00
Simulation period number= 7
Simulation period duration in days=25550.00
Number of grid columns= 15
Number of grid rows= 7
Grid spacing in ft=   100.00
X-coordinate of upper-left grid node in ft=   100.00
Y-coordinate of upper-left grid node in ft=   100.00

Aquifer actual porosity as a decimal= 0.300
Aquifer effective porosity as a decimal= 0.200
Simulation period number= 1
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 2
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 3
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 4
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 5
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 6
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 7
Aquifer thickness in ft= 33.00

Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day= 0.16
Number of point sources= 1
Simulation period number= 1
Point source number 1
X-coordinate of point source in ft= 0.00
Y-coordinate of point source in ft= 400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 290.000
Time after slug contaminant injection in days= 3650.00

Simulation period number= 2
Point source number 1
X-coordinate of point source in ft= 0.00
Y-coordinate of point source in ft= 400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 290.000
Time after slug contaminant injection in days= 7300.00
Simulation period number= 3
Point source number 1
X-coordinate of point source in ft= 0.00
Y-coordinate of point source in ft= 400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 290.000
Time after slug contaminant injection in days=10950.00
Simulation period number= 4
Point source number 1
X-coordinate of point source in ft= 0.00
Y-coordinate of point source in ft= 400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 290.000
Time after slug contaminant injection in days=14600.00
Simulation period number= 5
Point source number 1
X-coordinate of point source in ft= 0.00
Y-coordinate of point source in ft= 400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 290.000
Time after slug contaminant injection in days=18250.00
Simulation period number= 6
Point source number 1
X-coordinate of point source in ft= 0.00
Y-coordinate of point source in ft= 400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 290.000
Time after slug contaminant injection in days=21900.00
Simulation period number= 7
Point source number 1
X-coordinate of point source in ft= 0.00
Y-coordinate of point source in ft= 400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 290.000
Time after slug contaminant injection in days=25550.00
Bulk density of dry aquifer skeleton in g/cu cm= 1.86
Aquifer distribution coefficient in ml/g= .0128
Number of monitor wells for which time-
concentration tables are desired= 1
Monitor well number= 1
I-coordinate of monitor well= 10
J-coordinate of monitor well= 1

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS: 3650.00

J-ROW				I-COLUMN				
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.01	0.02	0.06	0.11	0.15	0.14	0.09	0.04
	0.09	0.31	0.80	1.47	1.92	1.78	1.17	0.55
	0.20	0.73	1.89	3.45	4.50	4.17	2.74	1.29
5	0.09	0.31	0.80	1.47	1.92	1.78	1.17	0.55
6	0.01	0.02	0.06	0.11	0.15	0.14	0.09	0.04
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

J-ROW				I-COLUMN				
	9	10	11	12	13	14	15	16
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
2	0.01	0.00	0.00	0.00	0.00	0.00	0.00	
3	0.18	0.04	0.01	0.00	0.00	0.00	0.00	
4	0.43	0.10	0.02	0.00	0.00	0.00	0.00	
5	0.18	0.04	0.01	0.00	0.00	0.00	0.00	
6	0.01	0.00	0.00	0.00	0.00	0.00	0.00	
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

3 10   0316

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS: 7300.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW				I-COLUMN				
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.03
2	0.00	0.00	0.00	0.01	0.03	0.07	0.14	0.24
3	0.00	0.00	0.01	0.04	0.11	0.25	0.51	0.85
4	0.00	0.00	0.02	0.06	0.16	0.39	0.78	1.31
5	0.00	0.00	0.01	0.04	0.11	0.25	0.51	0.85
6	0.00	0.00	0.00	0.01	0.03	0.07	0.14	0.24
7	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.03

J-ROW				I-COLUMN				
	9	10	11	12	13	14	15	16
1	0.04	0.05	0.05	0.04	0.03	0.02	0.01	
2	0.34	0.40	0.41	0.35	0.25	0.15	0.08	
3	1.21	1.45	1.46	1.24	0.89	0.54	0.28	
4	1.86	2.22	2.24	1.91	1.37	0.83	0.42	
5	1.21	1.45	1.46	1.24	0.89	0.54	0.28	
6	0.34	0.40	0.41	0.35	0.25	0.15	0.08	
7	0.04	0.05	0.05	0.04	0.03	0.02	0.01	

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS:10950.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW				I-COLUMN				
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

J-ROW	1	2	3	4	5	6	7	8
5	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.04
6	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

J-ROW				I-COLUMN				
	9	10	11	12	13	14	15	16
1	0.01	0.02	0.03	0.05	0.07	0.10	0.11	
2	0.03	0.07	0.13	0.21	0.31	0.40	0.47	
3	0.08	0.17	0.30	0.50	0.73	0.95	1.10	
4	0.11	0.22	0.40	0.66	0.96	1.26	1.46	
5	0.08	0.17	0.30	0.50	0.73	0.95	1.10	
6	0.03	0.07	0.13	0.21	0.31	0.40	0.47	
7	0.01	0.02	0.03	0.05	0.07	0.10	0.11	

3 10 0317

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS:14600.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW				I-COLUMN				
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

J-ROW				I-COLUMN				
	9	10	11	12	13	14	15	16
1	0.00	0.00	0.00	0.00	0.01	0.02	0.03	
2	0.00	0.00	0.01	0.01	0.03	0.06	0.10	
3	0.00	0.00	0.01	0.03	0.06	0.11	0.19	
4	0.00	0.01	0.01	0.03	0.07	0.13	0.23	
5	0.00	0.00	0.01	0.03	0.06	0.11	0.19	
6	0.00	0.00	0.01	0.01	0.03	0.06	0.10	
7	0.00	0.00	0.00	0.00	0.01	0.02	0.03	

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS:18250.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW				I-COLUMN				
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

J-ROW				I-COLUMN				
	9	10	11	12	13	14	15	16

2	0.00	0.00	0.00	0.00	0.00	0.00	0.01
3	0.00	0.00	0.00	0.00	0.00	0.00	0.01
4	0.00	0.00	0.00	0.00	0.00	0.00	0.01
5	0.00	0.00	0.00	0.00	0.00	0.00	0.01
6	0.00	0.00	0.00	0.00	0.00	0.00	0.01
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS:21900.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

3 10   0318

J-ROW				I-COLUMN				
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

J-ROW				I-COLUMN				
	9	10	11	12	13	14	15	16
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS:25550.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW				I-COLUMN				
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

J-ROW				I-COLUMN				
	9	10	11	12	13	14	15	16
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

MONITOR WELL COMPUTATION RESULTS:

TIME-CONCENTRATION TABLE

MONITOR WELL NUMBER: 1

TIME(DAYS)	CONCENTRATION(MG/L)
3650.000	0.10
7300.000	2.22
10950.000	0.22
14600.000	0.01
18250.000	0.00
21900.000	0.00
25550.000	0.00

3 10   0319

REFERENCES

Walton, William C. 1987. Groundwater Pumping Tests. Lewis Publishers, Chelsa, MI.

Walton, William C. 1988. Analytical Groundwater Modeling. Lewis Publishers, Chelsea, MI.

DATA BASE:

Number of simulation periods for which contaminant
concentration distribution is to be calculated 7

Simulation period number= 1
Simulation period duration in days= 3650.00
Simulation period number= 2
Simulation period duration in days= 7300.00
Simulation period number= 3
Simulation period duration in days=10950.00
Simulation period number= 4
Simulation period duration in days=14600.00
Simulation period number= 5
Simulation period duration in days=18250.00
Simulation period number= 6
Simulation period duration in days=21900.00
Simulation period number= 7
Simulation period duration in days=25550.00
Number of grid columns= 15
Number of grid rows= 7
Grid spacing in ft=   100.00
X-coordinate of upper-left grid node in ft=   100.00
Y-coordinate of upper-left grid node in ft=   100.00
Aquifer actual porosity as a decimal= 0.300
Aquifer effective porosity as a decimal= 0.200
Simulation period number= 1
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 2
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 3
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 4
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 5
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 6
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 7
Aquifer thickness in ft= 33.00

1,2-DCE

Note: All concentrations
in μg/L, not mg/L.

3 10   0321

Aquifer longi... dispersivity in ft= ...
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 1
Point source number 1
X-coordinate of point source in ft=   0.00
Y-coordinate of point source in ft=   400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l=   31.000
Time after slug contaminant injection in days= 3650.00
Simulation period number= 2
Point source number 1
X-coordinate of point source in ft=   0.00
Y-coordinate of point source in ft=   400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l=   31.000
Time after slug contaminant injection in days= 7300.00
Simulation period number= 3
Point source number 1
X-coordinate of point source in ft=   0.00
Y-coordinate of point source in ft=   400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l=   31.000
Time after slug contaminant injection in days=10950.00
Simulation period number= 4
Point source number 1
X-coordinate of point source in ft=   0.00
Y-coordinate of point source in ft=   400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l=   31.000
Time after slug contaminant injection in days=14600.00
Simulation period number= 5
Point source number 1
X-coordinate of point source in ft=   0.00
Y-coordinate of point source in ft=   400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l=   31.000
Time after slug contaminant injection in days=18250.00
Simulation period number= 6
Point source number 1
X-coordinate of point source in ft=   0.00
Y-coordinate of point source in ft=   400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l=   31.000
Time after slug contaminant injection in days=21900.00
Simulation period number= 7
Point source number 1
X-coordinate of point source in ft=   0.00
Y-coordinate of point source in ft=   400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l=   31.000
Time after slug contaminant injection in days=25550.00
Bulk density of dry aquifer skeleton in g/cu cm= 1.85
Aquifer distribution coefficient in ml/g= .0236
Number of monitor wells for which time-
concentration tables are desired= 1
Monitor well number= 1
X-coordinate of monitor well= 10
Y-coordinate of monitor well= 1

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS: 3650.00

J-ROW				I-COLUMN				
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.00
3	0.01	0.04	0.09	0.17	0.20	0.16	0.09	0.03
4	0.03	0.10	0.25	0.43	0.52	0.42	0.23	0.09
5	0.01	0.04	0.09	0.17	0.20	0.16	0.09	0.03
6	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

J-ROW				I-COLUMN				
	9	10	11	12	13	14	15	16
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
3	0.01	0.00	0.00	0.00	0.00	0.00	0.00	
4	0.02	0.00	0.00	0.00	0.00	0.00	0.00	
5	0.01	0.00	0.00	0.00	0.00	0.00	0.00	
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

3 10   0323

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS: 7300.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW				I-COLUMN				
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.03
3	0.00	0.00	0.00	0.01	0.02	0.04	0.07	0.11
4	0.00	0.00	0.00	0.01	0.02	0.06	0.11	0.18
5	0.00	0.00	0.00	0.01	0.02	0.04	0.07	0.11
6	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.03
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

J-ROW				I-COLUMN				
	9	10	11	12	13	14	15	16
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
2	0.03	0.04	0.03	0.03	0.02	0.01	0.00	
3	0.15	0.16	0.14	0.11	0.06	0.03	0.01	
4	0.24	0.26	0.23	0.17	0.10	0.05	0.02	
5	0.15	0.16	0.14	0.11	0.06	0.03	0.01	
6	0.03	0.04	0.03	0.03	0.02	0.01	0.00	
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS:10950.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW				I-COLUMN				
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

```
4     0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.01
5     0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.01
6     0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
7     0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

4

J-ROW   I-COLUMN
         9   10   11   12   13   14   15   16

```
1     0.00   0.00   0.00   0.01   0.01   0.01   0.01
2     0.01   0.01   0.02   0.03   0.04   0.05   0.05
3     0.01   0.03   0.05   0.07   0.10   0.12   0.13
4     0.02   0.04   0.07   0.10   0.14   0.16   0.17
5     0.01   0.03   0.05   0.07   0.10   0.12   0.13
6     0.01   0.01   0.02   0.03   0.04   0.05   0.05
7     0.00   0.00   0.00   0.01   0.01   0.01   0.01
```

3 10   0324

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS:14600.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW   I-COLUMN
         1   2   3   4   5   6   7   8

```
1     0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
2     0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
3     0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
4     0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
5     0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
6     0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
7     0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

J-ROW   I-COLUMN
         9   10   11   12   13   14   15   16

```
1     0.00   0.00   0.00   0.00   0.00   0.00   0.00
2     0.00   0.00   0.00   0.00   0.01   0.01   0.02
3     0.00   0.00   0.00   0.01   0.01   0.02   0.03
4     0.00   0.00   0.00   0.01   0.01   0.02   0.04
5     0.00   0.00   0.00   0.01   0.01   0.02   0.03
6     0.00   0.00   0.00   0.00   0.01   0.01   0.02
7     0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS:18250.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

-ROW   I-COLUMN
         1   2   3   4   5   6   7   8

```
1     0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
2     0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
3     0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
4     0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
5     0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
6     0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
7     0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
```

-ROW   I-COLUMN
         9   10   11   12   13   14   15   16

2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS:21900.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW				I-COLUMN				
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

J-ROW				I-COLUMN				
	9	10	11	12	13	14	15	16
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS:25550.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW				I-COLUMN				
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

J-ROW				I-COLUMN				
	9	10	11	12	13	14	15	16
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

MONITOR WELL COMPUTATION RESULTS:

TIME-CONCENTRATION TABLE

MONITOR WELL NUMBER: 1

TIME(DAYS)	CONCENTRATION(MG/L)
3650.000	0.00
7300.000	0.26
10950.000	0.04
14600.000	0.00
18250.000	0.00
21900.000	0.00
25550.000	0.00

3 10 0326

DATA BASE:

Number of simulation periods for which contaminant
concentration distribution is to be calculated 7

Simulation period number= 1
Simulation period duration in days= 3650.00
Simulation period number= 2
Simulation period duration in days= 7300.00
Simulation period number= 3
Simulation period duration in days=10950.00

Simulation period number= 4
Simulation period duration in days=14600.00
Simulation period number= 5
Simulation period duration in days=18250.00
Simulation period number= 6
Simulation period duration in days=21900.00
Simulation period number= 7
Simulation period duration in days=25550.00
Number of grid columns= 15
Number of grid rows= 7
Grid spacing in ft=   100.00
X-coordinate of upper-left grid node in ft=   100.00
Y-coordinate of upper-left grid node in ft=   100.00
Aquifer actual porosity as a decimal= 0.300
Aquifer effective porosity as a decimal= 0.200
Simulation period number= 1
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 2
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 3
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 4
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 5
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 6
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 7
Aquifer thickness in ft= 33.00

Aquifer longitudinal dispersivity in ft= 60.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day= 0.16
Number of point sources= 1
Simulation period number= 1
Point source number 1
X-coordinate of point source in ft= 0.00
Y-coordinate of point source in ft= 400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 13.000
Time after slug contaminant injection in days= 3650.00
Simulation period number= 2
Point source number 1
X-coordinate of point source in ft= 0.00
Y-coordinate of point source in ft= 400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 13.000
Time after slug contaminant injection in days= 7300.00
Simulation period number= 3
Point source number 1
X-coordinate of point source in ft= 0.00
Y-coordinate of point source in ft= 400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 13.000
Time after slug contaminant injection in days=10950.00
Simulation period number= 4
Point source number 1
X-coordinate of point source in ft= 0.00
Y-coordinate of point source in ft= 400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 13.000
Time after slug contaminant injection in days=14600.00
Simulation period number= 5
Point source number 1
X-coordinate of point source in ft= 0.00
Y-coordinate of point source in ft= 400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 13.000
Time after slug contaminant injection in days=18250.00
Simulation period number= 6
Point source number 1
X-coordinate of point source in ft= 0.00
Y-coordinate of point source in ft= 400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 13.000
Time after slug contaminant injection in days=21900.00
Simulation period number= 7
Point source number 1
X-coordinate of point source in ft= 0.00
Y-coordinate of point source in ft= 400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l= 13.000
Time after slug contaminant injection in days=25550.00
Bulk density of dry aquifer skeleton in g/cu cm= 1.86
Aquifer distribution coefficient in ml/g= .0224
Number of monitor wells for which time-
concentration tables are desired= 1
Monitor well number= 1
X-coordinate of monitor well= 10
Y-coordinate of monitor well= 4

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS: 3650.00

J-ROW	I-COLUMN							
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.02	0.04	0.07	0.08	0.07	0.04	0.02
4	0.01	0.04	0.10	0.18	0.22	0.18	0.10	0.04
5	0.00	0.02	0.04	0.07	0.08	0.07	0.04	0.02
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

J-ROW	I-COLUMN						
	9	10	11	12	13	14	15
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.01	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00

$3_{16}10$ 0329

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS: 7300.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW	I-COLUMN							
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
3	0.00	0.00	0.00	0.00	0.01	0.01	0.03	0.05
4	0.00	0.00	0.00	0.00	0.01	0.02	0.05	0.07
5	0.00	0.00	0.00	0.00	0.01	0.01	0.03	0.05
6	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

J-ROW	I-COLUMN							
	9	10	11	12	13	14	15	16
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
2	0.01	0.02	0.01	0.01	0.01	0.00	0.00	
3	0.06	0.07	0.06	0.05	0.03	0.01	0.01	
4	0.10	0.11	0.10	0.07	0.05	0.02	0.01	
5	0.06	0.07	0.06	0.05	0.03	0.01	0.01	
6	0.01	0.02	0.01	0.01	0.01	0.00	0.00	
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS:10950.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW	I-COLUMN							
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00		

J-ROW	1	2	3	4	5	6	7	8
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

J-ROW				I-COLUMN				
	9	10	11	12	13	14	15	16
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
2	0.00	0.00	0.01	0.01	0.02	0.02	0.02	
3	0.01	0.01	0.02	0.03	0.04	0.05	0.05	
4	0.01	0.01	0.03	0.04	0.06	0.07	0.07	
5	0.01	0.01	0.02	0.03	0.04	0.05	0.05	
6	0.00	0.00	0.01	0.01	0.02	0.02	0.02	
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

3 10   0330

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS:14600.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW				I-COLUMN				
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

J-ROW				I-COLUMN				
	9	10	11	12	13	14	15	16
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
2	0.00	0.00	0.00	0.00	0.00	0.00	0.01	
3	0.00	0.00	0.00	0.00	0.00	0.01	0.01	
4	0.00	0.00	0.00	0.00	0.01	0.01	0.02	
5	0.00	0.00	0.00	0.00	0.00	0.01	0.01	
6	0.00	0.00	0.00	0.00	0.00	0.00	0.01	
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS:18250.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW				I-COLUMN				
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

J-ROW				I-COLUMN				
	9	10	11	12	13	14	15	16

1	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS:21900.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW				I-COLUMN				
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

J-ROW				I-COLUMN				
	9	10	11	12	13	14	15	16
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS:25550.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

ROW				I-COLUMN				
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

ROW				I-COLUMN				
	9	10	11	12	13	14	15	16
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

MONITOR WELL COMPUTATION RESULTS:

TIME-CONCENTRATION TABLE

MONITOR WELL NUMBER: 1

3 10   0332

TIME(DAYS)	CONCENTRATION(MG/L)
3650.000	0.00
7300.000	0.11
10950.000	0.01
14600.000	0.00
18250.000	0.00
21900.000	0.00
25550.000	0.00

DATA BASE:

Number of simulation periods for which contaminant
concentration distribution is to be calculated 7

Simulation period number= 1
Simulation period duration in days= 3650.00
Simulation period number= 2
Simulation period duration in days= 7300.00
Simulation period number= 3
Simulation period duration in days=10950.00
Simulation period number= 4
Simulation period duration in days=14600.00
Simulation period number= 5
Simulation period duration in days=18250.00
Simulation period number= 6
Simulation period duration in days=21900.00
Simulation period number= 7
Simulation period duration in days=25550.00
Number of grid columns= 15
Number of grid rows= 7
Grid spacing in ft=   100.00
X-coordinate of upper-left grid node in ft=   100.00
Y-coordinate of upper-left grid node in ft=   100.00
Aquifer actual porosity as a decimal= 0.300
Aquifer effective porosity as a decimal= 0.200
Simulation period number= 1
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepate velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 2
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 3
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 4
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 5
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 6
Aquifer thickness in ft= 33.00
Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 7

Aquifer longitudinal dispersivity in ft= 30.00
Aquifer transverse dispersivity in ft= 6.00
Seepage velocity in ft/day=   0.16
Number of point sources= 1
Simulation period number= 1
Point source number 1
X-coordinate of point source in ft=   0.00
Y-coordinate of point source in ft=   400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l=   10.000
Time after slug contaminant injection in days= 3650.00
Simulation period number= 2
Point source number 1
X-coordinate of point source in ft=   0.00
Y-coordinate of point source in ft=   400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l=   10.000
Time after slug contaminant injection in days= 7300.00
Simulation period number= 3
Point source number 1
X-coordinate of point source in ft=   0.00
Y-coordinate of point source in ft=   400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l=   10.000
Time after slug contaminant injection in days=10950.00
Simulation period number= 4
Point source number 1
X-coordinate of point source in ft=   0.00
Y-coordinate of point source in ft=   400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l=   10.000
Time after slug contaminant injection in days=14600.00
Simulation period number= 5
Point source number 1
X-coordinate of point source in ft=   0.00
Y-coordinate of point source in ft=   400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l=   10.000
Time after slug contaminant injection in days=18250.00
Simulation period number= 6
Point source number 1
X-coordinate of point source in ft=   0.00
Y-coordinate of point source in ft=   400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l=   10.000
Time after slug contaminant injection in days=21900.00
Simulation period number= 7
Point source number 1
X-coordinate of point source in ft=   0.00
Y-coordinate of point source in ft=   400.00
Slug point source solute inject. vol. in gal= 69000.00
Slug point source solute concentration in mg/l=   10.000
Time after slug contaminant injection in days=25550.00
Bulk density of dry aquifer skeleton in g/cu cm= 1.86
Aquifer distribution coefficient in ml/g= .0176
Number of monitor wells for which time-
concentration tables are desired= 1
Monitor well number= 1
I-coordinate of monitor well= 10
J-coordinate of monitor well= 4

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS: 3650.00 .

J-ROW				I-COLUMN				
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.01	0.03	0.05	0.07	0.06	0.04	0.01
4	0.01	0.03	0.07	0.13	0.16	0.14	0.09	0.04
5	0.00	0.01	0.03	0.05	0.07	0.06	0.04	0.01
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

J-ROW				I-COLUMN				
	9	10	11	12	13	14	15	16
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
4	0.01	0.00	0.00	0.00	0.00	0.00	0.00	
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS: 7300.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW				I-COLUMN				
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
3	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.03
4	0.00	0.00	0.00	0.00	0.01	0.02	0.03	0.05
5	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.03
6	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

J-ROW				I-COLUMN				
	9	10	11	12	13	14	15	16
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
2	0.01	0.01	0.01	0.01	0.01	0.00	0.00	
3	0.04	0.05	0.05	0.04	0.03	0.01	0.01	
4	0.07	0.08	0.08	0.06	0.04	0.02	0.01	
5	0.04	0.05	0.05	0.04	0.03	0.01	0.01	
6	0.01	0.01	0.01	0.01	0.01	0.00	0.00	
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS:10950.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW				I-COLUMN				
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

J-ROW				I-COLUMN				
	5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

J-ROW				I-COLUMN				
	9	10	11	12	13	14	15	16
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
2	0.00	0.00	0.01	0.01	0.01	0.01	0.02	
3	0.00	0.01	0.01	0.02	0.03	0.04	0.04	
4	0.00	0.01	0.02	0.03	0.04	0.05	0.05	
5	0.00	0.01	0.01	0.02	0.03	0.04	0.04	
6	0.00	0.00	0.01	0.01	0.01	0.01	0.02	
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

3 10 0336

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS:14600.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW				I-COLUMN				
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

J-ROW				I-COLUMN				
	9	10	11	12	13	14	15	16
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
3	0.00	0.00	0.00	0.00	0.00	0.00	0.01	
4	0.00	0.00	0.00	0.00	0.00	0.01	0.01	
5	0.00	0.00	0.00	0.00	0.00	0.00	0.01	
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS:18250.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW				I-COLUMN				
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

J-ROW				I-COLUMN				
	9	10	11	12	13	14	15	16

1	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS:21900.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

J-ROW				I-COLUMN				
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

J-ROW				I-COLUMN				
	9	10	11	12	13	14	15	16
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

NODAL COMPUTATION RESULTS:

SIMULATION PERIOD DURATION IN DAYS:25550.00

VALUES OF CONTAMINANT CONCENTRATION (MG/L) AT NODES:

-ROW				I-COLUMN				
	1	2	3	4	5	6	7	8
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

-ROW				I-COLUMN				
	9	10	11	12	13	14	15	16
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	

MONITOR WELL COMPUTATION RESULTS:

TIME-CONCENTRATION TABLE

MONITOR WELL NUMBER: 1

TIME(DAYS)	CONCENTRATION(MG/L)
3650.000	0.00
7300.000	0.08
10950.000	0.01
14600.000	0.00
18250.000	0.00
21900.000	0.00
25550.000	0.00

3 10 0338

APPENDIX C

TOXICITY PROFILES FOR RISK ASSESSMENT CHEMICALS

1,1-dichloroethene (1,1-DCE), also known as 1,1-dichloroethylene or vinylidene chloride, is a colorless, volatile liquid with a sweet odor. 1,1-DCE enters the atmosphere from its production in the manufacture of plastics. It is also released in wastewater during plastics manufacturing and metal finishing.

Fate

1,1-DCE's high vapor pressure and water solubility and low organic carbon partition coefficient indicate environmental mobility. When spilled on land, 1,1-DCE will be partially lost by evaporation and partially by leaching into the groundwater. Slow hydrolysis and biodegradation should occur in the groundwater. The aquatic fate of 1,1-DCE is loss by evaporation to the atmosphere with a half-life of 1-6 days. Little absorption into aquatic sediments should occur. In the atmosphere, 1,1-DCE is photochemically reactive. It will degrade by reaction with hydroxyl radicals with a half-life of 11 hours in relatively clean air or less than 2 hours in polluted air (NLM 1989).

Human Health Effects

1,1-DCE is absorbed by ingestion, inhalation and dermal routes. In studies on rats, 1,1-DCE administered in drinking water caused hepatic lesions (LOAEL 9 mg/kg/day) (U.S. EPA 1990). This chemical is fetotoxic, but not teratogenic to rodents after exposure in drinking water or by inhalation. Based on studies of inhalation exposure in mice, 1,1-DCE is considered a possible human carcinogen. 1,1-DCE is mutagenic. Oral exposure has been shown to result in adrenal tumors in rats and inhalation exposure has produced kidney tumors in mice (U.S. EPA 1990).

Environmental Effects

Static bioassays resulted in 96-hour LC_{50}s of 169,000 ug/l for fathead minnows and 74,000 ug/l 24 hr for bluegills (NLM 1989). No experimental information is available on the bioconcentration of 1,1-DCE in aquatic invertebrates or fish. Significant bioconcentration is not expected because of the low octanol/water coefficient (log K_{ow} = 1.48) (NLM 1989).

1,1-Dichloroethane, also called ethylidene dichloride, is a colorless, oily liquid with an aromatic ethereal odor and a saccharine taste. It is released into the environment as fugitive air emissions and in wastewater resulting from its production and use as a chemical intermediate. 1,1-Dichloroethane is mobile in the environment, with a moderate water solubility (5500 mg/l), high vapor pressure (230 mm Hg at 25°C) and low organic carbon partition coefficient (43). It has a log octanol water partition coefficient of 1.9.

Fate

1,1-Dichloroethane which is released to the soil will be lost rapidly through evaporation. There is a possibility for leaching into the ground water due to its low soil adsorptivity. 1,1-Dichloroethane released to surface water will also be lost primarily through volatilization, with half-lives of 6-9 days for ponds, 5-8 days for lakes, and 24-32 hours for rivers. Adsorption to sediment, biodegradation and hydrolysis should be insignificant. When released into the atmosphere, 1,1-dichloroethane degrades by reaction with photochemically produced hydroxyl radicals, with a half-life of 62 days. 1,1-Dichloroethane will dispose considerably in the atmosphere and will be washed out by rain due to its moderate solubility in water (NLM 1989).

Human Health Effects

1,1-Dichloroethane can be absorbed into the human body by inhalation, ingestion and skin or eye contact. It produces central nervous system depression, respiratory tract irritation and skin burns. The impact of 1,1-dichloroethane on human organs has not yet been defined, with one study showing the chemical to cause liver and kidney damage, and other studies showing relatively low capacity to cause liver or kidney injury even on repeated exposure. 1,1-Dichloroethane is about one-half as toxic as 1,2 dichloroethane. It is an

experimental teratogen and tumorigen, but has not been shown to be mutagenic. 1,1-Dichloroethane has been classified by EPA as a possible human carcinogen based on limited evidence in animals (U.S. EPA 1990).

Environmental Effects

The estimated concentration factor for 1,1-dichloroethane is 1.3, indicating insignificant bioconcentration in fish. All of the chloroethanes have a whole body elimination half-life in exposed bluegills of less than two days (NLM 1989).

1,1,1-Trichloroethane (TCA) is a colorless, non-flammable, sweet smelling liquid commonly used for degreasing and metal cleaning. 1,1,1-Trichloroethane, also known as methyl chloroform, enters the environment through air emissions or in wastewater resulting from its production or use. It is found in many products used in the home such as cleaners, glues, paints and aerosol sprays (NLM 1989)

Fate

Due to its high vapor pressure (100 mm Hg at 20°C) 1,1,1-trichloroethane will evaporate fairly rapidly into the atmosphere. The half-life for aquatic fate will range from hours to a few weeks depending on wind and mixing conditions. 1,1,1-Trichloroethane is fairly stable in the atmosphere and is transported long distances. It degrades slowly by reaction with hydroxyl radicals with a half-life ranging from 6 months to 75 years. Atmospheric degradation is increased by the presence of chlorine radicals and nitrogen oxides. The amount of 1,1,1-trichloroethane in the atmosphere is increasing by 12-17% annually. Some TCA is returned to the earth through rainfall. The adsorption of 1,1,1-trichloroethane to soil is proportional to the organic carbon content of the soil. Since it is frequently found in ground water in high concentrations, one can conclude that it is not strongly adsorbed to soils (NLM 1989).

Human Health Effects

1,1,1-Trichloroethane is a central nervous system and respiratory depressant and an irritant to the skin and mucous membranes. Mild liver and kidney dysfunction may occur transiently following recovery from central nervous system depression (NLM 1990) 1,1,1-Trichloroethane is absorbed rapidly through the lungs and gastrointestinal tract, but cutaneous absorption is probably too slow to produce significant toxicity unless the

chemical is trapped against the skin by an impermeable barrier (NLM 1989). It may cause transient increases in liver enzymes and translet renal impairment. There are no confirmed human or animal data that have lead to the classification of 1,1,1-trichloroethane as a carcinogen (USEPA 1990).

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Environmental Effects

For a 96 hour bioassay, fathead minnows had an LC_{50} of 52.8 mg/l for a flow-through test and 105 mg/l for a static test. The 7-day LC_{50} reported for the guppy was 133 ppm. The bioconcentration factor in bluegill sunfish in a 28 day test was 8.9, indicating little tendency to bioconcentrate in fish (NLM 1990).

1,1,2-TRICHLOROETHANE (CAS #79-00-5)

1,1,2-Trichloroethane is a colorless, tasteless liquid with a sweet odor. It has a vapor pressure of 760 mm Hg at 113.9°C. It readily corrodes aluminum and its alloys and is relatively water-soluble. 1,1,2-Trichloroethane is used in the manufacture of the vinylidene chloride and as a solvent. It is an indirect food additive for use as an adhesive compound.

Fate

When released to the land, 1,1,2-trichloroethane will partially volatilize and partially leach into the ground water. Biodegradation is not likely to occur. The aquatic fate of 1,1,2-trichloroethane is loss by volatilization with a half-life of days to weeks. Little will be adsorbed by sediment or biodegraded. In the atmosphere, 1,1,2-trichloroethane will degrade by reacting with hydroxyl radicals with a half-life of 24 days. Polluted atmospheres lessen the half-life. Some may wash out in the rain (NLM 1990).

Human Health Effects

1,1,2-Trichloroethane is rapidly absorbed from the lungs and gastrointestinal tract. It is excreted primarily by the lungs, with some via the kidneys. In laboratory studies with mice, 1,1,2-trichloroethane has been shown to alter levels of clinical serum chemistries. It has been classified as a possible human carcinogen by EPA, based on a laboratory study of mice (U.S. EPA 1990).

Environmental Effects

1,1,2-Trichloroethane is not expected to bioconcentrate in fish. The log of the bioconcentration factor is less than 1. The octanol/water partition coefficient (log K_{ow}) is 2.17 (NLM 1990).

1,1,2,2-Tetrachloroethane is a heavy, colorless to pale yellow liquid with a sweetish, suffocating, chloroform-like odor. It is considered corrosive and may attack plastics, rubber, and coatings. 1,1,2,2-Tetrachloroethane is soluble in acetone and has a vapor pressure of 9 mm Hg at 30°C.

Fate

When released to the soil, 1,1,2,2-Tetrachloroethane will volatilize due to its moderate vapor pressure. A small amount may be adsorbed to the soil and leach into the ground water. There is evidence of slow biodegradation. The aquatic fate of 1,1,2,2-tetrachloroethane is loss by evaporation to the atmosphere with a half-life of days to weeks. Biodegradation may occur where the water is rich in microorganisms, but the product (1,1,2-trichloroethane) is resistant to further degradation. 1,1,2,2-Tetrachloroethane is practically inert in the troposphere with a half-life of more than 800 days. Some may return to earth in the form of rain. It will diffuse slowly into the stratosphere where it will photodissociate (NLM 1990).

Human Health Effects

1,1,2,2-Tetrachloroethane is readily absorbed through the skin, the lung, and the gastrointestinal tract. It is readily excreted by the lungs. EPA has classified it as a possible human carcinogen based on increased incidence of hepatocellular carcinomas in mice (U.S. EPA 1990).

Ninety-six hour LC_{50} values (static bioassay) were 12,300 ug/l for Mysid shrimp and Sheepshead minnow and 21,300 ug/l for bluegill. The octanol/water partition coefficient (log K_{ow}) for 1,1,2,2-tetrachloroethane is 2.39. The log bioconcentration factor (BCF) in fish is 0.9 to 1. The whole-body BCF for bluegill is 8, for a 14 day exposure (NLM 1990).

1,2-DICHLOROETHANE (CAS #107-06-2)

1,2-Dichloroethane is a clear, colorless, flammable oily liquid with a pleasant odor and a sweet taste. 1,2-Dichloroethane, also known as ethylene dichloride or EDC, is used widely in the manufacture of ethylene glycol, PVC, nylon, and other plastics. It has a vapor pressure of 100 mm Hg at 29.4°C.

Fate

Releases of 1,2-dichloroethane will evaporate fairly rapidly due to its high vapor pressure. 1,2-Dichloroethane has a low coefficient for adsorption, indicating a tendency for mobility into the ground water. It will leach rapidly through sandy soils. Releases to surface water will be lost primarily through evaporation. A modeling study using the Exams model for a eutrophic lake gave a half-life of 10 days. A shorter half-life would be expected for rivers and streams due to mixing and turbulence. Chemical and biological degradation are expected to be slow. 1,2-Dichloroethane which is released to the atmosphere will degrade by reaction with hydroxyl radicals formed photochemically in the atmosphere. The half-life for losses through photooxidation is a little over a month. The photooxidation of 1,2-dichloroethane in water is expected to be slow. The products of photooxidation are CO_2 and HCl. 1,2-Dichloroethane is expected to be transported long distances in the atmosphere and washed out in rain (NLM 1989).

Human Health Effects

The main routes of entry are through inhalation of the vapor or skin absorption of the vapor or liquid. Inhalation of high concentrations may cause nausea, vomiting, mental confusion, dizziness, and pulmonary edema. Chronic exposure has been associated with liver and kidney damage. Direct skin contact causes smarting of the skin and first-degree burns on short exposure. Long-term skin exposure may cause secondary burns. Repeated skin

contact can cause defatting of the skin, severe irritation, fissured dermatitis and moderate edema (NLM 1989). Death is usually ascribed to circulatory and respiratory failure.

1,2-Dichloroethane is classified as a probable human carcinogen (U.S. EPA, 1990). The single oral dose LD50 determined for male and female CD-1 mice were 483 and 413 mg/kg, respectively. Skin adsorption LD50 values of 4.9 g/kg and 2.8 g/kg have been determined with rabbits (NLM 1989).

Environmental Effects

Due to its low octanol/water partition coefficient, 1,2-dichloroethane is not expected to bioconcentrate in fish. The measured log bioconcentration factor in bluegill sunfish is 0.30. 1,2-Dichloroethane has been reported to be non-toxic to many economically important plant species. The 24-hour LC50 for Daphnia magna was reported to be 250 mg/l. Static 24-hour and 96-hour LC50 concentrations of >600 mg/l and 430 mg/l (NLM 1989).

1,2-Dichloroethene is a colorless, flammable liquid with a slightly acrid, chloroform-like odor. 1,2-Dichloroethene is most often used in the production of solvents and in chemical mixtures. It is often a by-product in the manufacture of chlorinated compounds. It can be present in two isomers, trans and cis.

Fate

1,2-Dichloroethane released to the soil will evaporate readily, or leach into the soil, where it will biodegrade very slowly. When released to the water, it will be lost mainly through volatilization, with a half-life of 3 hours in a model river. Biodegradation and adsorption of 1,2-dichloroethene to sediment should not be significant. In the atmosphere, 1,2-dichloroethene will degrade by reaction with photochemically produced hydroxyl radicals, with half-lives of 8 and 3.6 days for the cis and trans isomers, respectively (NLM 1989).

Human Health Effects

Exposure to 1,2-dichloroethene vapors can cause nausea, vomiting, weakness, tremor, epigastric cramps and central nervous system depression. Exposure to the eye may results in reversible corneal clouding. 1,2-Dichloroethene is considered toxic by inhalation, skin contact or ingestion. The chemical is largely excreted through the lungs (NLM 1989). It has not been evaluated by EPA for human carcinogenicity (U.S. EPA, 1990).

Environmental Effects

The recommended octanol/water partition coefficients for cis- and trans-1,2-dichloroethene are 1.86 and 2.06, respectively. One can estimate a bioconcentration factor of between 15 and 22, indicating that 1,2-dichloroethene will not bioconcentrate significantly in aquatic organisms (NLM 1989).

1,2-dichloropropane, also known as propylene dichloride and propylene chloride, is a colorless liquid with an unpleasant, chloroform-like odor. 1,2-dichlorpropane is used as a soil fumigant, and in cleaning, degreasing, and spot removal operations including paint and varnish removal. It is also used during extraction processes of fats, oils, lactic acid and petroleum waxes, and in the manufacture of tetrachloroethylene and propylene oxide. 1,2-dichloropropane is found as an additive in antiknock fluids (NLM 1990).

Fate

1,2-dichloropropane is released into soil when used as a fumigant, and into air as fugitive emissions and in wastewater during its production and use as a chemical intermediate, scouring, spotting and metal degreasing agent. It is very volatile and if released in air, will degrade by reaction with photochemically produced hydroxyl radicals and will be washed out by rain. If released into water, 1,2- dichloropropane will be lost by volatilization with half-lives ranging from approximately 5-8 hours in a river and 10 days in a lake. If released on soil, 1,2-dichlorpropane will rapidly volatilize and readily leach into the ground especially in sandy soils. Some may leach into groundwater where its fate is unknown (NLM 1990).

Human Health Effects

The main routes of entry for 1,2-dichloropropane are through inhalation of the vapors, ingestion, eye and skin contact, and contaminated drinking water. It may cause dermatitis by defatting the skin and more severe irritation may occur of it is confined against the skin by clothing. Undiluted, 1,2-dichloropropane is moderately irritating to the eyes, but does not cause permanent injury. Animal experiments have shown that acute exposure produced central nervous system narcosis, and fatty degeneration of the liver and kidneys (NIOSH, 1977).

Environmental Effects

An LC_{50} value of 139,300 ug/l/96 hr was found for fathead minnows (Pimephales promelas) exposed to 1,2-dichloropropane in water while guppies (Poecilia reticulata) had values of 116 ppm/7 days. The cladoceran, Daphnia magna, has been reported to have a LC_{50} of 52,500 ug/l/96 hr (NLM 1990).

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Chloroform is a clear, colorless and mobile liquid with a characteristic odor and a sweet taste. It is slightly soluble in water (5 ml/l) and has a high vapor pressure (100 mg Hg at 10.4°C). Chloroform is nonflammable, but will burn on prolonged exposure to flame or high temperature. Most of the chloroform manufactured in the United States (93%) is used to make fluorocarbon-22, a refrigerant (ATSDR 1989b). Chloroform is also used as a grain fumigant; a chemical intermediate for dyes and pesticides; and a solvent for pesticides, adhesives, oils and other compounds. It was previously used as a surgical anesthetic and as an ingredient in cough syrups, toothpastes and liniments, but the FDA has banned the use of chloroform in drugs, cosmetics and food packaging (NLM 1989).

Fate

Chloroform which is released to the atmosphere may be transported long distances before being degraded by reaction with photochemically generated hydroxyl radicals. The half-life for this reaction is approximately 3 months. Removal of chloroform from the atmosphere in precipitation may be significant; however, most of this chloroform will reenter the atmosphere through volatilization. Volatilization is the primary fate process for chloroform released to water, with a half-life of 1-31 days. Chloroform released to the soil will either volatilize rapidly or leach readily through the soil and enter the ground water. Chloroform will adsorb strongly to peat moss, less strongly to clay and limestone, and not at all to sand. Chloroform is predicted to persist in the ground water for relatively long periods of time (ATSDR 1989b).

Human Health Effects

Chloroform is absorbed readily through the lungs and intestines. The three principal target organs of chloroform toxicity are the liver, kidneys, and central nervous system. Short-

term exposure to high concentrations of chloroform in the air can cause fatigue, dizziness and headache. Other symptoms of chloroform exposure include respiratory depression, coma, kidney and liver damage, and death. Rapid death is attributable to cardiac arrest, while delayed death results form kidney or liver damage (ATSDR 1989). Chloroform is classified as a probable human carcinogen. It is considered highly fetotoxic, but not teratogenic (U.S. EPA 1990).

Environmental Effects

The bioconcentration factor of chloroform in four different fish species was found to be less than 10 times the concentration in ambient water, suggesting little tendency for chloroform to bioconcentrate in aquatic organisms. A 27 day flow-through test showed an LC_{50} in rainbow trout of 2030 ug/l in soft water and 1240 ug/l in hard water. Static 96 hr tests showed LC_{50}s of 43,800 ug/l for rainbow trout and 100,000 ug/l for bluegills (NLM 1989).

Ethylbenzene is a colorless flammable liquid with a pungent odor. It is used in the manufacture of cellulose acetate, styrene and synthetic rubber. It is also used as a solvent or diluent and as a component of automotive and aviation gasoline. the primary source of exposure is from the air especially in areas of high traffic.

Fate

Ethylbenzene will decrease in concentration by evaporation and biodegradation. Representative half-lives are several days to 2 weeks. It is only adsorbed moderately by soil and may leach into the groundwater.

When released onto soil, Ethylbenzene will biodegrade slowly. Evaporation from water will occur rapidly into the atmosphere with a half-life ranging from several hours to a few weeks. After the population of degrading micro-organisms becomes established, biodegradation will occur rapidly. The half-life for this process is 2 days. Ethylbenzene will be removed from the atmosphere principally by reaction with photochemically produced hydroxyl radical. Additional quantities will be removed by rain. Some Ethylbenzene will be adsorbed by the sediment (NLM 1989).

Human Health Effects

Ethylbenzene liquid and vapor are irritating to the eyes, nose, throat and skin. The liquid is a low grade cutaneous irritant, and repeated contact may produce a dry, scaly and fissured dermatitis. Acute exposure to high concentrations may produce irritation of the mucous membranes of the upper respiratory tract, nose and mouth, followed by symptoms of narcosis, cramps, paralysis and death due to respiratory failure. Effects of short-term exposure will lead to decreased manual dexterity and prolonged reaction time. Long term overexposure may damage the liver and central nervous system.

Animals exposed through dermal and/or ingestive routes may suffer central nervous system depression. Guinea pigs exposed to concentrations of 1% experienced ataxia, loss of consciousness, tremors throughout the extremities and finally death through respiratory failure. Rats given chronic oral doses of 408-680 mg/kg/day for 182 days suffered from liver and kidney abnormalities. Laboratory animals exposed to airborne concentrations ranging from 5000 to 10,000 ppm had intense congestion and edema of the lung (NLM 1989). Based on its octanol/water partition coefficient, ethylbenzene should not significantly bioconcentrate in aquatic organisms.

Environmental Effects

LC50s of 12.1 and 32 mg/l have been reported for fathead minnows and bluegills, respectively (NLM 1989). A bioconcentration factor of 37.5 has been reported for fish (U.S. EPA 1986).

Methylene chloride, also known as dichloromethane, is a colorless liquid with a sweet, chloroform-like odor. It is used as a paint remover, degreaser, and low temperature extractant of substances which are adversely affected by high temperature. Due to its high vapor pressure (400 mg Hg at 24.1°C), methylene chloride is expected to volatilize readily.

Fate

Methylene chloride which is spilled onto the land will primarily evaporate due to its high vapor pressure. Some methylene chloride is assumed to leach through the soil into the ground water, although data on adsorptivity are lacking. Methylene chloride released to surface water will be lost by evaporation taking several hours depending on wind and mixing conditions. Biodegradation is possible in surface waters, but will probably be slow compared to evaporation. Hydrolysis is not an important degradation process with a minimum half-life of 18 months. Degradation in ground water is unknown. Methylene chloride released to the atmosphere will degrade by reaction with hydroxyl radicals, with a half-life of several months. A small fraction of the chemical will diffuse to the stratosphere where it will degrade rapidly by photolysis and reaction with chlorine radicals. Methylene chloride is partially returned to earth in precipitation (NLM 1989).

Human Health Effects

Methylene chloride is a mild narcotic. Effects of intoxication include headaches, irritability, numbness and tingling in the limbs. The liquid and vapors are irritating to the eyes and upper respiratory tract at higher concentrations. The primary route of human exposure is through inhalation. Once inside the body, methylene chloride is absorbed through the body membranes and rapidly enters the bloodstream (ATSDR 1989c). If the liquid is held in contact with the skin, severe burns may develop. In severe cases of overexposure,

observers have noted toxic encephalopathy with hallucinations, pulmonary edema, coma and death. Cardiac arrhythmias have been produced in animals, but have not been common in human experiences. Methylene chloride is classified as a probable human carcinogen (NLM 1990).

Environmental Effects

The 96-hour LC_{50} for the fathead minnow was 193 mg/l in a flow-through test and 310 mg/l in a static test. The LC_{50} for the bluegill was 230 mg/l and 220 mg/l for 24- and 96-hour tests, respectively (conditions unspecified). The LC_{50} for the guppy in a 14-day test was 294 ppm and 224 mg/l for Daphnia magna in a 48-hour test. Although experimental data are lacking, methylene chloride is not expected to bioconcentrate due to its low octanol/water partition coefficient, log K_{ow} equals 1.25 (NLM 1989).

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Styrene is a colorless to yellowish oily liquid with a characteristic sweet, balsamic, almost floral odor. Exposure to high levels of styrene may occur through contact with unsaturated polyester resin products used in fiberglass boat construction and repair and as autobody fillers and casting plastics, where concentrations may range from 30 to 50%. Styrene is commonly a component of floor waxes and polishes, paints, metal cleaners, and varnishes (NLM 1990a).

Fate

Styrene released into the environment will partition into the atmosphere because of its high vapor pressure, low density and low water solubility. Nevertheless, it does not absorb solar radiation at wavelengths above the solar cutoff, therefore, it will not be directly photolyzed in the lower atmosphere or surface water. Styrene, however, is involved with indirect photochemical reactions and has been found to be one of the most active generators of photochemical smog. Styrene reacts quickly with hydroxyl radicals and with ozone, with reaction half-lives of 3.5 and 9 hours, respectively. The volatilization half-life of styrene from water is also fairly rapid--about 3 hours (NLM 1990).

Styrene released to soils is subject to biodegradation. Soil mobility may be low to moderate and is dependent on soil conditions. Styrene can leach through soil into underlying ground water, and has been found to persist in soil up to two years (NLM 1990).

Human Health Effects

Exposure to styrene by the general population may be through ingestion of food which has been packaged in polystyrene, by ingestion of contaminated finished drinking water, by inhalation of air contaminated by industrial sources, auto exhaust, or incineration

emissions and by inhalation of smoke from cigarettes. Styrene is absorbed into the bloodstream through all routes, including ingestion, inhalation, and percutaneous absorption. Exposure to styrene vapor among workers may cause central nervous system depression and irritation of the eyes, skin and upper respiratory tract. Elevated incidence of hematopoietic and lymphatic cancer has been reported for workers in the styrene-butadience rubber industry (NLM 1990). Laboratory studies with dogs reported red blood cell and liver effects (U.S. EPA 1990).

Environmental Effects

Styrene does not bioaccumulate or bioconcentrate in organisms and food chains to any measurable extent due to its relatively high water solubility. In goldfish, a bioconcentration factor (BCF) of 13.5 has been calculated. LC_{50} values for fathead minnows (Pimephales promelas) in both hard and soft water and from 24 to 96 hour periods ranged from 46.4 to 62.8 mg/l. Brine shrimp (Artemia salina) were found to have LC_{50} values of 68 mg/l/24 hr and 52 mg/l/48 hr. Guppies (Leibistes reticulatus), bluegill (Lepomis macrochirus) and goldfish (Carassius auratus) at water hardness of 20 mg/l calcium carbopnate and at 96 hours of exposure had LC_{50} values of 74.8, 25.1, 64.7 mg/l, respectively (NLM 1990).

TETRACHLOROETHENE (CAS #127-18-4)

Tetrachloroethene, also known as perchloroethylene (PCE), is a colorless, tasteless liquid with a mildly sweet odor. PCE has a vapor pressure of 18.47 mm Hg at 25°C. It enters the atmosphere as fugitive air emissions from dry cleaning and metal degreasing industries (NLM 1989).

Fate

When spilled on the land, PCE will evaporate into the atmosphere. It has a low to medium mobility in soil, but it may leach through sandy soils into the ground water. PCE is not expected to hydrolyze. It may biodegrade in the soil under anaerobic conditions. It can also be transformed by reductive dehalogenation under anaerobic conditions to trichloroethylene, dichloroethylene, and vinyl chloride.

The aquatic fate of PCE is loss by evaporation to the atmosphere. The half-life may vary from less than one day to several weeks. No significant hydrolization, biodegradation, bioconcentration in aquatic organisms, or absorption to sediment should occur. It decomposes slowly in water to yield trichloroacetic acid and hydrochloric acid.

In the atmosphere, PCE exists mainly in the gas phase. It is subject to photooxidation with a half-life anywhere from one hour to two months. Some PCE may wash out in the rain. The primary degration product is phosgene (NLM 1989).

Human Health Effects

Tetrachloroethylene is absorbed by inhalation of contaminated air and ingestion of contaminated drinking water. Inhalation is the principal route by which PCE enters the body, followed by the oral route. Dermal absorption is minimal by comparison. It is

considered a probable human carcinogen currently under study (USEPA 1990). Once in the bloodstream, PCE tends to concentrate in human body fat and the brain. It may cause liver irregularities, respiratory tract irritation, conjunctivitis, dermatitis or inflammation of the skin, and depress the central nervous system (NLM 1989).

Environmental Effects

Available data for PCE indicate that acute and chronic toxicity to freshwater aquatic life can occur at concentrations around 5,280 and 840 ug/l, respectively (U.S. EPA 1985). The bioconcentration factor (BCF) of tetrachloroethylene in fathead minnows is 38.9 and in bluegill sunfish is 49 (NLM 1989).

TRICHLOROETHENE (CAS #79-01-6)

Trichloroethene (TCE), also known as trichloroethylene or acetylene trichloride, is a clear, colorless liquid with a sweet odor. Tho odor is detectable at a level of 50 ppm. TCE is soluble in chloroform, acetone, alcohol, and ether. Its solubility in water is 1.110 mg/L at 25°C. The vapor pressure is 19.9 mm Hg at 0°C. TCE is used for vapor degreasing of metals. It is also used as a chemical intermediate in the production of pesticides, waxes, gums, resins, tars, and paints. It is not known to occur as a natural product. TCE enters the atmosphere as air emissions from metal degreasing plants and as wastewater from metal finishing, paint and ink formulation, electrical/electronic components, and rubber processing industries (NLM 1989).

Fate

When released to the land, TCE evaporates readily due to its high vapor pressure. It may also leach through the soil and into the ground water, where it may remain for a long time. There is some evidence of degradation in the soil to form other chlorinated alkenes. The aquatic fate of TCE is loss by evaporation with a half-life ranging from minutes to hours, depending upon the turbulence of the water. Biodegradation, hydrolysis, and photooxidation will occur at a much slower rate. In the atmosphere, TCE will react fairly rapidly, especially under smog conditions. An atmospheric residence time of 5 days has been reported with the formation of phosgene, dichloroacetyl chloride, and formyl chloride (NLM 1989).

Human Health Effects

Exposure to trichlorethylene vapor may cause irritation of the eyes, nose and throat. Repeated or prolonged skin contact with the liquid may cause dermatitis. Acute exposure to TCE depresses the central nervous system exhibiting such symptoms as headaches,

dizziness, vertigo, tremors, nausea, blurred vision and irregular heart beat. If splashed in the eyes, the liquid may cause burning irritation and severe damage. Prolonged occupational exposures to TCE have been associated with impairment of peripheral nervous system function. Alcohol may make symptoms of overexposure worse. The LD_{50} for humans is 50 to 500 mg/kg (NLM 1989).

TCE is recognized as a probable human carcinogen. The aggregate risk of cancer due to exposure to TCE is 4.1 cases per year for persons living within 50 km of emission sources (51 Federal Register 7714).

Environmental Effects

Ninety-six hour LC_{50} data range from 2,000 ug/l to 66,800 ug/l for grass shrimp and fathead minnows, respectively. Marine monitoring data suggest moderate bioconcentration (2 to 25 times). The bioconcentration factor (BCF) for bluegill sunfish and rainbow trout ranges between 17 and 39. The octanol/water partition coefficient (log K_{ow}) is 2.29 (NLM 1989).

Vinyl chloride is a flammable gas at room temperature and is usually encountered as a cooled liquid. The colorless liquid forms a vapor which has a pleasant ethereal odor. It is used primarily in the manufacture of polyvinyl chloride and other resins.

<u>Fate</u>

If vinyl chloride is released to the soil, it will be subject to rapid volatization based on a reported vapor pressure of 2600 mm Hg at 25°C. Any vinyl chloride not evaporating will be expected to be highly mobile in the soil and may leach to the ground water. The half-lives of 0.2 and 0.5 days were reported for terrestrial fate. When released to water, vinyl chloride will rapidly volatilize with an estimated half-life of 0.805 hours.

Existing data indicate that vinyl chloride is resistant to biodegradation in aerobic systems. The rate constant for the vapor phase reaction of vinyl chloride with photochemically produced hydroxyl radicals has been determined to be 6.6×10^{-12} cm^3 molecule-sec at 26°C. This process has a half-life of 1.5 days at an atmospheric concentration 8×10^5 hydroxy radicals per cm^3. In waters containing photosensitizers such as humic acid, photodegradation will occur fairly rapidly (NLM 1989).

<u>Human Health Effects</u>

Vinyl chloride is a skin irritant and contact with the liquid may cause frostbite upon evaporation. The eyes may be immediately and severely irritated. Vinyl chloride depresses the central nervous system. Chronic exposure may cause hepatic damage. Nausea and dulling of visual and auditory responses may develop in acute exposures. It has been classified as a human carcinogen, and a causal agent of angiosarcoma of the liver. Cancer of the lung, lymphatic and nervous systems has also been reported.

A review of data obtained from various carcinogenicity studies of vinyl chloride revealed that cancer developed on a dose and time basis. Inhaled vinyl chloride was carcinogenic in mice and rats. The frequency of deaths increased with concentrations and total exposure time. Recent inhalation studies with albino CD1 mice and CD rats confirmed the carcinogenicity of vinyl chloride at concentrations as low as 50 ppm.

Environmental Effects

After a 10 day exposure at 338 ppm complete mortality was reported during a test involving northern pike (NLM 1989). Sax (1984) reports a TLM 96 for aquatic organisms (concentration that will kill 50 percent of the exposed organisms within 96 hours) of over 1000 ppm. A bioconcentration factor of 1.17 was reported for fish (U.S. EPA 1986).

1,2,4-TRICHLOROBENZENE (CAS #120-82-1)

1,2,4-Trichlorobenzene (124-TCB) is a colorless, aromatic liquid. Major commercial uses are as a dye carrier, a synthesis intermediate, a dielectric fluid and as a solvent.

Fate

Its strong tendency to adsorb on solids accounts for low volatility from soils and turbid water. Although mobility through ground water is expected to be minimal due its high coefficient of adsorption to soils, and the fact that it will not hydrolyze under environmental conditions, 124-TCB can be found at appreciable concentrations in ground water. 124-TCB may biodegrade slowly in soil but is not expected to biodegrade in ground water. If released to surface water, its major fate pathway would be adsorption to the sediments, although evaporation may be significant if suspended sediments are low. Absorption by microorganisms and a fairly high bioconcentration potential also could affect pathway distribution. 124-TCB is expected to be relatively persistent in soils and sediments. Half-lives in rivers have been reported from 4.2 hours to 28 days. In the atmosphere, reaction with photochemically produced hydroxyl radicals results in an estimated vapor phase half-life of 18.5 days (NLM 1989).

Human Health Effects

124-TCB is absorbed from the gastrointestinal tract, intact skin and lung. Principal toxicological concerns from which oral reference doses have been determined are associated with enzyme induction at dose levels of 10 mg/kg/day and increased liver-to-body ratios effective at higher oral dose levels in rate subchronic studies. One study reported no adverse effect levels of 14.8 and 8.9 mg/kg/day, respectively, for female and male rats. 124-TCB has been designated by the U.S. EPA as not classifiable as to carcinogenicity (U.S. EPA 1990).

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Holcombe et al. (1987), Carlson and Kosian (1987) and McCarty et al. (1985) reported 96-hr LC50s in the range of 1.5 to 3.0 mg/l for fathead minnows and trout. Acute values (48-hr LC50) for Daphnia range from 3.4 to 50 mg/l (Holcombe et al. 1987; NLM 1989). Maximum acceptable toxicant concentrations of 290 to 707 ug/l for fatheads and 126 ug/l for trout were reported by Barnthouse and Suter (1986) and McCarty et al. (1985) with respective NOECs of 119 to 507 and 99 ug/l. Bioconcentration factors for Daphnia were reported as 141 and for fish as 813 to 3,162 (NLM 1989).

Butylbenzylphthalate is a clear, oily liquid with a slight odor. It is used as a plasticizer for polyvinyl and cellulose resins, primarily in polyvinylchloride (NLM 1990).

Fate

Butylbenzylphthalate released to the atmosphere has an estimated half-life of 1-5 days. Since its vapor pressure is only 8.6×10^{-6} my Hg at 20 degrees Centigrade, volatilization of butylbenzylphthalate is not expected to be a significant transport mechanism. Phthalate esters in air are expected to be controlled by hydroxyl radical attack, while adsorption onto particulates and rainout are less important fate processes. Butylbenzylphthalate released to water will partition to solids, sediment and biota. Photodegradation and hydrolysis is not significant since the half-lives for these processes are greater than 100 days. It has a low Henry's Law constant, therefore, volatilization from water will not be significant except from shallow rivers or during high wind activity. If released to land, benzylbutylphthalate should not leach appreciably, although it has been detected in groundwater. The most significant fate process for butylbenzylphthalate in soil is biodegradation. Because of its low volatility, evaporation from soil is not considered to be significant (NLM 1990).

Human Health Effects

Exposure to butylbenzylphthalate can occur through inhalation, ingestion, and dermal absorption. Toxicity studies with rats produced significantly increased liver-to-body weight and liver-to-brain weight ratios (U.S. EPA 1990). Butylbenzylphthalate has been identified as a possible human carcinogen (U.S. EPA 1990).

Environmental Effects

Biodegradation of Butylbenzylphthalate is rapid and extensive in natural water and sewage systems and is readily degraded by mixed microbial cultures. It has not been found to be an accumulative or persistent chemical in fish. In fish the half-life may be as short as 1.5 hours, yielding 99% clearance in 24 hours. LC_{50} values of 62 mg/l/24 hr and 43 mg/l/96 hr were found in bluegill sunfish (Lepomis macrochirus). In alga, EC_{50} values ranged from 130 to 1×10^6 ug/l/96 hr with a toxic effect on cell number (NLM 1990).

DI-N-BUTYLPHTHALATE (CAS #84-74-2)

Di-n-butylphthalate, also known as dibutyl phthalate, is a colorless to faint yellow viscous liquid, with a slight, but characteristic ester odor. It is used primarily to soften plastics such as raincoats, car interiors, vinyl fabrics and floor tiles. Dibutyl phthalate is also used in products such as nail polish, aftershave lotion, adhesives and caulking (NLM 1990).

Fate

Di-n-butylphthalate exists primarily as particulate matter and is subject to gravitational settling when released into the atmosphere. It has an estimated half-life of 18 hours in air and the free molecule will photodegrade by reaction with hydroxyl radicals. In water, di-n-butylphthalate will adsorb moderately to sediment and complex with humic material in the water column. Biodegradation rates are rapid with 90-100% degradation in 3-5 days in industrial rivers, and 2-17 days in water from a variety of estuarine and freshwater conditions. Although it biodegrades under anaerobic conditions, its fate in groundwater remains unknown. Di-n-butylphthalate will adsorb to a moderate extent and will slowly biodegrade in soil (66 to 98% degradation in 26 weeks from two soils) (NLM 1990).

Human Health Effects

Exposure to dibutyl phthalate may occur through inhalation, ingestion or dermal routes. It can be found in wastewater emissions during production and use, incineration of plastics and migration from products from which it is constructed. Exposure may also occur from drinking water and food products. Contact may cause burns to skin and eyes. Breathing plasticizers as sprays can cause throat irritation. Problems with menstrual disorders and higher rates of miscarriages, reduced gestation and delivery rates have been reported among women who worked in industries where phthalates were used. Di-n-butyl phthalate has not been classified as a carcinogen as both human and animal studies are not available (U.S. EPA 1990).

Di-n-butyl phthalate is readily metabolized and does not bioaccumulate in fish to any extent. Studies of clams (Neanthes virens), american oysters, brown shrimp and sheepshead minnow reported similar findings. Dibutyl phthalate is toxic to synchronously developing larvae of the brine shrimp, Artemia. An LC_{50} value of 0.21 mg/l/1500 hr were found in scud (Gammarus fasciatus), while the alga, Gymnodinium breve, was reported to have a LC_{50} value of 0.02-0.6 ppm/96 hr (NLM 1990).

Di-n-octylphthalate is a liquid at room temperature and a hazardous constituent of industrial wastewater or caustic cleaning wastes from equipment and tank cleaning from paint manufacturing. Di-n-octylphthalate is also found in emission control dust or sludge from paint manufacturing and other plasticizers (U.S. EPA 1990c).

Fate

Di-n-octylphthalate has an estimated half-life in air of 13.8 hours. In water, it adsorbs to sediment and particulate matter in the water column, with one study showing an estimated half-life of 5 days. Di-n-octyl phthalate strongly sorbs to soil and does not readily leach into groundwater. Nevertheless, it has been found in drinking water derived from ground water, although its fate in ground water is unknown. Di-n-octylphthalate will slowly leach or volatilize from plastics during normal use or in landfills. Surfactants, fulvic acid, dispersed fats or oils or other substances with a hydrophobic character can solubilize phthalates in the environment (NLM 1990).

Human Health Effects

Since phthalates are of very low acute oral toxicity, the primary hazard for Di-n-octylphthalate is in handling. Exposure to phthalic anhydride in the form of a dust, fume or vapor may result in irritation of the eyes, skin and respiratory tract. Conjunctivitis and skin erythema, burning and contact dermatitis may occur. Inhalation of the dust or vapors may cause coughing, sneezing, and a bloody nasal discharge. Repeated exposure could result in bronchitis, emphysema, allergic asthma, urticaria and chronic eye irritation. It can also be a central nervous system depressant if absorbed (NLM 1990).

Environmental Effects

Di-n-octylphthalate bioconcentrates in algae and other aquatic organisms, although the data are contradictory in fish. LC_{50} values of 6.18 and 33,900 ug/l/7-8 days were found in redear sunfish (Lepomis microlopus) and large mouth bass (Micropterus salmoides), respectively. The channel catfish, Ictarus punctatus, was reported to have a LC_{50} value of 630 ug/l/7 days (NLM 1990).

BIS (2-ETHYLHEXYL) PHTHALATE (CAS #117-81-7)

Bis (2-ethylhexyl) phthalate, also known as di (2-ethylhexyl) phthalate or DEHP, is a colorless or light colored oil liquid with a slight odor. It is commonly used as a plasticizer for PVC resins. Other uses include pesticide formulations, dielectric fluids and solvents. Although there have been reports suggesting natural sources of the chemical, they are negligible compared to manmade sources (ATSDR 1989a). Bis (2-ethylhexyl) phthalate has a low vapor pressure (1.32 mm Hg at 200°C).

Fate

Bis (2-ethylhexyl)phthalate has a strong tendency to adsorb to soil and sediment, particularly organic-rich soils. Due to its low volatility, bis (2-ethylhexyl) phthalate will tend not to evaporate when discharged to the land or water. DEHP has been shown to biodegrade under aerobic conditions, with a half-life of several days. Biodegradation under anaerobic conditions occurs very slowly if at all. Evaporation of DEHP from surface waters is likely to be negligible, with sediments playing a more important role in determining the fate of the chemical. Because of its low vapor pressure and strong adsorptive tendency, atmospheric DEHP will have a strong tendency to adsorb to atmospheric particulates and be removed in precipitation (ATSDR 1989a).

Human Health Effects

Bis (2-ethylhexyl) phthalate is absorbed well through the gastro-intestinal tract following ingestion. Once absorbed, DEHP is distributed through the body with the liver and testes being main target organs. Elimination from the body is rapid, with only a slight cumulative potential.

Reported LC_{50} values for the coho salmon, channel catfish, rainbow trout and bluegill were greater than 100 mg/l for a 96-hour static test. Other tests reported LC_{50}s of greater than 770 mg/l for bluegills in a 96-hour test and 1,000-5,000 μg/l for Daphnia magna in a 48-hour test. Bis (2-ethylhexyl) phthalate does have a tendency to bioconcentrate in aquatic organisms. Experimental log bioconcentration factors range from 2 to 4 in fish and invertebrates. The bioconcentration factor for rainbow trout was 42-113 for a 36 day test. Fathead minnow had a bioconcentration factor of 115-886 in a 56 day test. The log octanol/water partition coefficient for bis (2-ethylhexyl) phthalate is 4.88 (NLM 1989).

Toxaphene is a mixture of more than 175 components produced by the chlorination of camphene. It has been used extensively as a pesticide on cotton as well as other crops.

Fate

Toxaphene is very persistent in the environment, and when released to soil will persist for periods of up to 14 years. It is not expected to leach to ground water or be removed significantly by runoff unless it is adsorbed to clay particles which are removed by runoff. Biodegradation may be enhanced by anaerobic conditions such as flooded soils. Evaporation from soils and surfaces will be a significant process for toxaphene. A reported KOC of 2.1 E+5 indicates that toxaphene will adsorb very strongly to soils and sediments (NLM 1989).

Human Health Effects

The fatal dose of toxaphene in man has been estimated to range from 2 to 7 grams. Fatal human poisonings, however, have been rare (Clayton and Clayton 1981). Nonfatal poisoning often begins in 4 hours or less after toxaphene is ingested. In fatal cases, severe symptoms have begun as early as half an hour after exposure. Death from uncomplicated toxaphene poisoning often occurs within the first 12 hours and occurred in one reported case in less than 4 hours after exposure (Hayes 1982). In a survey of 199 employees who worked or had worked with toxaphene between 1949 and 1977, 20 employees died, 1 with cancer of the colon. None of the deaths appeared to be related to exposure to toxaphene. Toxaphene is classified by the EPA as a probable human carcinogen.

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Toxaphene toxicities in birds include an oral LD50 of 71 mg/kg for mallards and 86 mg/kg for bobwhite quail (3-5 month old birds). 96-hour LC50s reported for fish include 2.4 mg/l for bluegills, 3.7 ug/l for carp, 13.1 ug/l of channel catfish, and 18 ug/l for fathead minnows. Acute toxicity of toxaphene to daphnids was reported in the range of 10-14 ug/l. BCF values reported for fish range from 3,100-33,000, indicating significant bioconcentration potential (NLM 1989).

POLYCHLORINATED BIPHENYLS (CAS #1336-69-1)

PCB-1254 (CAS #11097-69-1)

The polychlorinated biphenyls (PCBs) are a class of chemical that contain a large number of congeners (groups of similar molecular composition, with two or more possible structural forms). For PCBs, 209 separate congeners are possible. The physical, chemical, and biological properties can vary among congeners. Commercially, the chemical composition of a PCB product was varied to obtain desirable properties for specific uses. Because of limitations in separation technology and analytical methods, all products consisted of mixtures of uncertain numbers of PCB chemicals and isomers. In practice, only about one-half of the possible 209 congeners occur in commercial PCB products. Composition of commercial PCB products were conventionally coded to indicate the percent by weight of chlorine present, e.g., Aroclor 1254 contained 54 percent chlorine.

Fate

The persistence of PCBs in the environment generally increases with an increase in the degree of chlorination. Although biodegradation of the higher chlorinated congeners occurs only slowly in soil systems, it is the only degradation process shown to be important. PCBs, particularly the higher chlorinated congeners, will not leach significantly from most soils; however, in the presence of organic solvents, such as may be present at waste sites, PCBs may leach quite rapidly to ground water. Vapor loss from soils is very slow, yet volatilization may be a significant loss mechanism over time owing to the persistence and stability of PCBs. In surface water, PCBs will tend to partition to sediments and suspended particulates. Adsorption can immobilize PCBs for relatively long periods. However, resolution of PCBs has been shown to occur, resulting in redistribution of PCBs into the environment over a long period of time from sediments initially contaminated and serving as sinks for substantial quantities of these compounds. Volatilization of dissolved PCBs may be a major removal mechanism. PCBs are highly lipophilic and bioaccumulate in tissue from concentrations in water (NLM 1989).

In air, PCBs exist in both the vapor phase and in association with the particulate adsorption phase. The higher chlorinated congeners will be more likely to be found adsorbed to particulates. Reaction with hydroxyl radicals may be the dominant transformation process in the atmosphere, but is active primarily on the lower chlorinated congeners associated with the vapor phase. Physical removal is accomplished by wet and dry deposition (NLM 1989).

Human Health Effects

Acute or chronic human exposure to PCBs may cause eye irritation, chloracne (acne-like eruptions of the skin), scaly skin, nervous system disorders, jaundice or atrophy of the liver, reproduction effects, liver enzyme induction, liver dysfunction, behavior deficits in offspring, and adverse developmental effects. The toxicity of PCB products appears generally to increase with increasing degree of chlorination. There is also evidence that excessive exposure to PCBs may adversely affect reproductive outcome.

The greatest potential PCB-related human health concern (based primarily on the results of animal studies) are from long-term, low-level exposure. There is experimental evidence of a carcinogenic effect when the highly chlorinated PCBs are administered at high doses to laboratory animals. The PCBs are considered to be known carcinogens in rodents and are classified as probable human carcinogens (U.S. EPA 1990).

PCBs may not be acutely toxic until the dose level reaches the mg/kg range (U.S. EPA 1980). Rats fed diets of Aroclor 1254 totaling 1,000 mg/kg all died in 53 days (Hudson et al. 1984). Eisler (1986) concluded that the total (sum of exposures) rat lethal dietary level of Aroclor 1254 is from 500 to 2,000 mg/kg for 1 to 7 week exposures.

In general, acute toxicity in aquatic organisms occurs in concentrations above 2 ug/l. The ninety-six hour LC_{50} value for newly hatched fathead minnows (Pimephales promelas), was 7.7 ug/l for Aroclor 1254 (U.S. EPA 1980). Fifteen-day intermittent flow bioassays carried out with bluegills (Lepomis macrochirus) using Aroclor 1242, 1248, and 1254 resulted in LC_{50} values of 54, 76 and 204 ug/l, respectively. Chronic toxicity values of 2.5 (NOEC), 7.5 (LOEC) and 4.3 (MATC) ug/l have been reported for Daphnia (U.S. EPA 1980).

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APPENDIX D

CALCULATION OF SUBSURFACE
SOIL REMEDIATION LEVELS

MEDLEY FARM SITE

Subsurface soil levels that are protective of human health and the environment are based on a compound's potential to impact groundwater above promulgated standards. A leaching model incorporating site-specific physical properties and environmental fate considerations is the best method for predicting chemical concentrations in groundwater. Factors to be considered include:

- annual infiltration
- chemical retardation
- fate mechanisms volatilization, biodegradation, hydrolysis
- soil type and properties
- groundwater flow.

The derivation of a generally applicable model using factors appropriate for the Medley Farm Site is presented below.

MODEL DERIVATION

The driving force for chemical transport to groundwater is infiltration. Bulk flow through the unsaturated zone can be represented by a continuous flushing model (EPA, 1988) as:

$$C_w = C_o(1-exp^{-t/\tau})$$

where:

C_w = aqueous concentration at the water table
C_o = aqueous concentration in the source area
t = time, years
τ = leaching constant for the system

The leaching constant, τ, is equal to the volume of unsaturated pore space divided by the volumetric flow rate of chemical, as:

$$\tau = \frac{V}{Q} = \frac{A * D * \theta}{A * V_c} = \frac{D\theta}{V_c}$$

where:

A = area of application, ft^2
D = unsaturated depth, ft
θ = volumetric moisture content
V_c = chemical transport velocity.

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The chemical transport velocity can be related to the bulk phase velocity through a retardation factor:

$$V_c = \frac{V_w}{R} = \frac{V_w}{(1 + pk_d/\theta)}$$

where:

V_w = bulk (water) velocity = infiltration rate, (ft/yr)
R = retardation factor
p = bulk density
k_d = distribution coefficient = foc * koc
foc = fraction organic carbon
koc = organic carbon partitioning coefficient.

The aqueous chemical concentration at the source, C_o, is related to the soil concentration by the distribution coefficient as:

$$C_o = C_s/k_D$$

where:

C_s - soil concentration.

This relationship assumes equilibrium between soil and leachate, a reasonable assumption considering the slow infiltration rates.

Chemical transport in the unsaturated zone can therefore be described as:

$$C_w = \frac{C_s}{k_D} (1 - \exp(-t\, V_w/D\theta(1 + pk_D/\theta)). \tag{1}$$

The C_s term is not constant and will decrease as chemicals in the soil are leached into the groundwater. The rate of concentration decrease is dependent on the retardation factor, infiltration rate and initial mass of chemical. The soil concentration at time i is equal to the mass of chemical at time i-1 minus the mass of chemical in the leachate divided by the volume of soils in the source area.

The soil concentration at time i can be expressed as:

$$C_{si} = C_{si-1} - \frac{(C_{si-1} V_w t)}{(k_D\, d\, p)} \tag{2}$$

D-2

where:

d = depth of source materials.

The model revises the equilibrium soil concentration at each time increment to account for the mass lost to leachate. The revised soil concentration is then input into Eq. 1 to calculate the leachate concentration at the interface of the unsaturated zone and the water table (C_w) The chemical concentration in groundwater, Cgw, is a function of the groundwater flow beneath the site. The relationship is:

$$Cgw = \frac{C_w Q_l}{Q_l + Qgw} \tag{3}$$

where:

Cqw = chemical concentration in groundwater
Q_l = leachate flow rate into aquifer
Qgw = groundwater flow rate beneath site.

The leachate flow rate (Q_l) is equal to the infiltration rate times the source area. The volumetric flow rate of groundwater (Qgw) is estimate as the specific discharge times the effective vertical cross-sectional area of the aquifer perpendicular to the groundwater flow across the contaminated area of the site:

$$Qgw = KiA_c \tag{4}$$

Where:

K = hydraulic conductivity (ft/day).
i = hydraulic gradient (ft/ft)
A_c = cross-sectional area of groundwater flow (ft^2).

The cross-sectional area of groundwater flow (A_c) is equal to the width of the source area perpendicular to groundwater flow, multiplied by the depth into the aquifer in which mixing of leachate occurs. This estimate mixing depth is estimated from the following formula (EPA, 1985):

$$Z = (d_z Y')^{0.5} \tag{5}$$

Where:

Z = mixing depth (ft)
d_z = vertical dispersivity
Y' = length of source area parallel to groundwater flow (ft).

The resulting chemical concentration in groundwater (Cqw) must be less than the groundwater remediation level for the soil concentration to be considered protective. The soil remediation level is calculated by selecting a starting soil concentration and comparing the calculated groundwater concentration with the groundwater standard. The recalculation of C_{si} is an interactive process that requires a trial-and-error solution for the soil remediation level. Starting values for Cs are input until a Cgw value equal to the groundwater standard is obtained.

SITE-SPECIFIC FACTORS

Soil properties and hydrologic values for the Medley Farm Site are presented in Table E.1. Organic carbon partitioning coefficients and groundwater remediation values are presented in Table E.2.

The vertical extent of source materials has been set at 10 feet. This value is based on the test pits placed through the former lagoons and is conservative, as the depth of fill materials was 3.5 feet or less (Appendix B of the RI). The vertical extent of source materials is used to define a mass of chemicals available for leaching into groundwater. The unsaturated depth beneath the source materials is set at 60 feet, based on the depths to groundwater found during the RI.

The fraction of organic carbon in site soils has been assumed to be 0.01 in the absence of actual measurements. While the clays and silts of the site are naturally low in organic matter, they have organophilic properties that retard the movement of organic compounds (Lyman, 1982). The assumed value represents an effective foc based on soil type and is conservative.

The highest concentrations of source materials are located almost exclusively in the former lagoon area. The source term area is based on the lagoon areas plus a 100% buffer zone to provide a conservative estimate of leachate volume.

The cross-sectional area of groundwater flow available for mixing with site leachate is the product of the source area width perpendicular to flow and the mixing depth in the aquifer. Groundwater flow in the former lagoon areas is to the southeast. The width of the former lagoons along this path is approximately 200 feet. Calculation of the mixing depth using Equation 5 requires input of the vertical dispersivity (d_z) and the source area length parallel to groundwater flow (Y'). The vertical dispersivity was set equal to the lateral dispersity value of 1.5 used in the groundwater transport modeling (Section 2.3). The source area length is measured from TP-4 to TP-14, a distance of approximately 350 feet. The mixing depth (Z) is calculated as :

$$Z = (d_z Y')^{0.5} = (1.5 \times 350)^{0.5}$$

$$= 23 \text{ feet.}$$

This depth is less than that of the combined saturated saprolite and transition zone beneath the site. Since the underlying bedrock contains VOCs at select locations, this depth is conservative.

The cross-sectional area for groundwater mixing at the site is then:

$$A_c = (200 \text{ ft}) (23 \text{ ft})$$
$$= 4600 \text{ ft}^2$$

Values for the hydraulic conductivity and gradient were determined in the RI. The groundwater flow beneath the site is therefore:

$$Q_{gw} = KiA_c$$
$$= (0.97 \text{ ft/d})(0.045)(4600 \text{ ft}^2)$$
$$= 200 \text{ ft}^3/\text{day}$$

CALCULATION OF PROTECTIVE SOIL LEVELS

Calculation of the soil remediation level for trichloroethene illustrates application of the model. The only chemical-specific input parameters are the organic carbon partitioning coefficient (koc) and the groundwater remediation level, which are presented in Table E.2. The remaining input parameters are site-specific and are presented in Table E.1.

1) Calculate retardation factor, R.

$$R = (1 + p\text{*foc*koc/}\theta)$$
$$= 1 + 1.9\text{*}0.01\text{*}126/0.2$$
$$= 13$$

2) Calculate unsaturated chemical transport velocity, Vc.

$$Vc = Vw/R$$
$$= (1 \text{ ft/yr})/13 = 0.077 \text{ ft/yr}$$

3) Calculate leaching constant, τ

$$\tau = D\theta/Vc$$
$$= (50 \text{ ft})(0.2)/(0.077 \text{ ft/yr}) = 130$$

Determination of a soil remediation level is an interactive process, as illustrated in Table E.4. An initial soil concentration value, Cs, is placed into Equation 1 to generate an equilibrium concentration at the water table. The mass of chemical lost to leaching is used to generate a new starting soil concentration calculated throughout the selected time period. A new starting value for Cs is input until the value for Cgw is equivalent to the groundwater

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remediation level. For TCE, the protective soil level of 500 ug/l is approximately 80 times the groundwater MCL of 5 ug/l. This finding is reasonable considering the type and depth of unsaturated soils, the flow of groundwater at the site, and the mobility of TCE.

Calculated soil remediation levels are based on protecting groundwater to MCLs, which are the most stringent groundwater levels evaluated for the Site. The soil remediation levels are therefore protective of maximum use of Site groundwater.

The model assumes that soils in the entire source area of 44,000 square feet to a depth of 10 feet are at the calculated soil remediation level. This approach greatly overestimates the potential to impact groundwater since the calculated soil remediation level is applied to individual, not average, concentrations. In addition, no consideration of chemical loss through natural degradation mechanisms is considered. Volatilization, for example, is a significant loss mechanism for volatile organics at the site. The absence of volatilization and other chemical reduction factors causes the model to overestimate the potential for chemical transport to groundwater. The application of average remediation levels to individual concentrations and the disregarding of natural attenuation mechanisms ensure that the given model is conservative and can be used to define potential remedial requirements.

Subsurface soil levels protective of MCLs in groundwater are summarized in Table E.3. Calculations of individual soil remediation levels for Site chemicals are presented in Tables E.4 through E.22.

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EPA, VHS model, Federal Register of November 27, 1985 (50 FR 48897).

EPA, Guidance on Remedial Actions for Contaminated Groundwater at Superfund Sites, December 1988 (EPA/540/G-88/003).

Lyman, W.R., et al, Handbook of Chemical Property Estimation Methods, McGraw Hill, New York, 1982.

TABLE D.1

SOIL PROPERTIES AND HYDROLOGIC VALUES USED IN THE MODEL

TERM	VALUE	SOURCE
Infiltration rate (I)	1.0 ft/yr	RI
Volumetric moisture content (θ)	0.2	RI
Bulk density (p)	1.9	Assumed value
Unsaturated depth (D)	60 ft	RI
Depth of source materials (d)	10 ft	RI
Fraction organic carbon (foc)	0.01	Assumed value
Source Area (A)	44,000 ft^2	Measured
Leachate flow rate (Qp)	120 ft^3/d	Calculated
Mixing depth (Z)	23 ft	Calculated
Hydraulic conductivity (k)	0.97 ft/d	RI
Hydraulic gradient (i)	0.045 ft/ft	RI
Groundwater flow area (Ac)	4600 ft^2	Calculated
Groundwater flow rate (Qgw)	200 ft^3/d	Calculated

CHEMICAL-SPECIFIC VALUES   3 10 0594

Compound	Koc	Groundwater Level (ug/l)	Source
1,1-Dichloroethane	30	3500	(1)
1,2-Dichloroethane	14	5	MCL
1,1-Dichloroethene	65	7	MCL
1,2-Dichloroethene (total)	54	70	MCL
1,1,1-Trichloroethane	152	200	MCL
1,1,2-Trichloroethane	56	5	PMCL
Trichloroethene	126	5	MCL
Tetrachloroethene	364	5	MCL
Chloroform	31	100	MCL
Methylene chloride	8.8	5	PMCL
Acenaphthalene	4600	2100	(1)
Acetone	2.2	3500	(1)
Benzoic Acid	65	140,000	(1)
1,4-Dichlorobenzene	1,700	75	MCL
Diethylphthalate	142	28,000	(1)
Bis(2-ethylhexyl)phthalate	10,000	4	PMCL
Phenol	14.2	21,000	(1)
1,2,4-Trichlorobenzene	9,200	9	PMCL
PCBs	530,000	0.5	MCL

(1)   No promulgated standard value available. Value given is a risk-based level protective of human health (Appendix E).

MCL -   Maximum Contaminant Level (40 CFR 141.61).
PMCL -   Proposed Maximum Contaminant Level (55 FR 30370).

TABLE D.3

SUBSURFACE SOIL LEVELS PROTECTIVE
OF GROUNDWATER (MCLs)

Volatile Organics	Soil Remediation Level (ug/kg)
1,1-Dichloroethane	70,000
1,2-Dichloroethane	60
1,1-Dichloroethene	270
1,2-Dichloroethene (total)	2,100
1,1,1-Trichloroethane	26,000
1,1,2-Trichloroethane	160
Trichloroethene	500
Tetrachloroethene	1,600
Chloroform	3,000
Methylene chloride	40

Semi-volatile Organics	
Acenaphthalene	13,000,000
Acetone	12,000
Benzoic Acid	5,500,000
1,4-Dichlorobenzene	150,000
Diethylphthalate	3,300,000
Bis(2-ethylhexyl)phthalate	84,000
Phenol	250,000
1,2,4-Trichlorobenzene	160,000
PCBs	400,000

TABLE D.4

ESTIMATED SUBSURFACE SOIL REMEDIATION LEVEL
MEDLEY FARM SITE
COMPOUND - TRICHLOROETHENE

Qp =   900 gal/day   Qgw =   1500 gal/day
 I = 0.305 m/yr   D =   15 meters
Koc =   126   d =   6 meters
R   =   12.97   foc =   0.01
1/T =   0.007838   Kd =   1.26 l/kg
Vol. moist. content = 0.2   MCL =   5 ug/l
Bulk density =   1.9

Time (years)	C/Co	Cs (ug/kg)	Cw (ug/l)	Cgw (ug/l)
0	0	500	0.0	0.00
1	0.007807	489	3.1	1.16
2	0.015554	469	6.0	2.27
3	0.023241	439	8.6	3.24
4	0.030867	401	10.7	4.03
5	0.038434	359	12.2	4.59
6	0.045942	313	13.1	4.91
7	0.053392	267	13.3	4.98
8	0.060783	221	12.9	4.82
9	0.068116	179	12.0	4.49
10	0.075392	141	10.7	4.02
11	0.082611	108	9.2	3.47
12	0.089774	81	7.7	2.89
13	0.096881	58	6.2	2.32
14	0.103933	41	4.8	1.80
15	0.110929	28	3.6	1.35
16	0.117871	18	2.6	0.98
17	0.124759	12	1.8	0.68
18	0.131593	7	1.2	0.46
19	0.138373	4	0.8	0.30

TABLE D.5

ESTIMATED SUBSURFACE SOIL REMEDIATION LEVEL
MEDLEY FARM SITE
COMPOUND - 1,1-DICHLOROETHANE

Q_p =	900 gal/day	Q_{gw} =	1500 gal/day	
I =	0.305 m/yr	D =	15 meters	
K_{oc} =	30	d =	6 meters	
R =	3.85	foc =	0.01	
1/T =	0.026406	K_d =	0.3 l/kg	
Vol. moist. content =	0.2	MCL =	3500 ug/l	
Bulk density =	1.9			

Time (years)	C/Co	Cs (ug/kg)	Cw (ug/l)	Cgw (ug/l)
0	0	70000	0.0	0.00
0.5	0.013116	66879	3060.6	1147.71
1	0.026061	60914	5809.8	2178.68
1.5	0.038836	52766	7885.6	2957.10
2	0.051443	43354	9048.2	3393.06
2.5	0.063885	33688	9232.3	3462.13
3	0.076164	24675	8552.8	3207.30
3.5	0.088281	16973	7261.2	2722.96
4	0.100240	10918	5671.3	2126.75
4.5	0.112042	6537	4077.8	1529.16
5	0.123689	3622	2695.1	1010.65
5.5	0.135183	1845	1632.1	612.03
6	0.146527	858	901.3	338.00
6.5	0.157721	361	451.1	169.15
7	0.168769	135	202.9	76.08
7.5	0.179672	45	81.1	30.43
8	0.190432	13	28.5	10.68
8.5	0.201051	3	8.6	3.23
9	0.211531	1	2.2	0.82
9.5	0.221873	0	0.5	0.17

TABLE D.6

ESTIMATED SUBSURFACE SOIL REMEDIATION LEVEL
MEDLEY FARM SITE
COMPOUND - 1,1-DICHLOROETHENE

Qp =   900 gal/day   Qgw =   1500 gal/day
 I =   0.305 m/yr   D =   15 meters
Koc =   65   d =   6 meters
 R =   7.175   foc =   0.01
1/T =   0.014169   Kd =   0.65 l/kg
Vol. moist. content = 0.2   MCL =   7 ug/l
Bulk density =   1.9

Time (years)	C/Co	Cs (ug/kg)	Cw (ug/l)	Cgw (ug/l)
0	0	275	0.0	0.00
1	0.014069	264	6.0	2.23
2	0.027941	242	11.3	4.25
3	0.041617	212	15.5	5.81
4	0.055101	177	18.0	6.74
5	0.068396	141	18.6	6.99
6	0.081503	106	17.6	6.62
7	0.094426	75	15.4	5.77
8	0.107167	51	12.4	4.66
9	0.119729	32	9.3	3.49
10	0.132114	19	6.5	2.43
11	0.144325	10	4.2	1.56
12	0.156364	5	2.5	0.93
13	0.168234	2	1.3	0.50
14	0.179936	1	0.7	0.25
15	0.191474	0	0.3	0.11
16	0.202850	0	0.1	0.05
17	0.214066	0	0.0	0.02
18	0.225124	0	0.0	0.01
19	0.236026	0	0.0	0.00

TABLE D.7

ESTIMATED SUBSURFACE SOIL REMEDIATION LEVEL
MEDLEY FARM SITE
COMPOUND - 1,2-DICHLOROETHANE

Qp = 900 gal/day		Qgw = 1500 gal/day		
I = 0.305 m/yr		D = 15 meters		
Koc = 14		d = 6 meters		
R = 2.33		foc = 0.01		
1/T = 0.043633		Kd = 0.14 l/kg		
Vol. moist. content = 0.2		MCL = 5 ug/l		
Bulk density = 1.9				

Time (years)	C/Co	Cs (ug/kg)	Cw (ug/l)	Cgw (ug/l)
0	0	58	0.0	0.00
0.25	0.010849	55	4.5	1.69
0.5	0.021580	50	8.5	3.19
0.75	0.032195	43	11.5	4.31
1	0.042695	35	13.1	4.89
1.25	0.053081	26	13.1	4.92
1.5	0.063354	19	11.9	4.47
1.75	0.073516	13	9.9	3.70
2	0.083568	8	7.5	2.80
2.25	0.093510	4	5.2	1.94
2.5	0.103345	2	3.3	1.22
2.75	0.113073	1	1.9	0.70
3	0.122695	0	1.0	0.36

TABLE D.8

ESTIMATED SUBSURFACE SOIL REMEDIATION LEVEL
MEDLEY FARM SITE
COMPOUND - 1,2-DICHLOROETHENE (TOTAL)

Qp =	900 gal/day	Qgw =	1500 gal/day	
I =	0.305 m/yr	D =	15 meters	
Koc =	54	d =	6 meters	
R =	6.13	foc =	0.01	
1/T =	0.016585	Kd =	0.54 l/kg	
Vol. moist. content =	0.2	MCL =	70 ug/l	
Bulk density =	1.9			

Time (years)	C/Co	Cs (ug/kg)	Cw (ug/l)	Cgw (ug/l)
0	0	2100	0.0	0.00
1	0.016448	1996	64.0	23.99
2	0.032626	1798	120.6	45.22
3	0.048537	1531	161.6	60.61
4	0.064187	1228	182.0	68.24
5	0.079580	923	180.9	67.84
6	0.094719	649	162.0	60.74
7	0.109609	424	131.7	49.39
8	0.124255	256	97.5	36.57
9	0.138659	142	65.7	24.64
10	0.152827	72	40.1	15.05
11	0.166762	33	22.1	8.29
12	0.180467	13	10.9	4.08
13	0.193947	5	4.7	1.79
14	0.207205	1	1.8	0.68
15	0.220245	0	0.6	0.22
16	0.233071	0	0.2	0.06
17	0.245686	0	0.0	0.01
18	0.258093	0	0.0	0.00
19	0.270296	0	0.0	0.00

TABLE D.9

ESTIMATED SUBSURFACE SOIL REMEDIATION LEVEL
MEDLEY FARM SITE
COMPOUND - 1,1,1-TRICHLOROETHANE

Q_p = 900 gal/day Q_{gw} =   1500 gal/day
 I = 0.305 m/yr D =   15 meters
K_{oc} =   152 d =   6 meters
R =   15.44 f_{oc} = 0.01
$1/T$ =   0.006584 K_d = 1.52 l/kg
Vol. moist. content = 0.2   MCL =   200 ug/l
Bulk density =   1.9

Time (years)	C/Co	Cs (ug/kg)	Cw (ug/l)	Cgw (ug/l)
0	0	26400	0.0	0.00
1	0.006562	25935	114.0	42.75
2	0.013082	25022	223.2	83.71
3	0.019560	23701	322.0	120.75
4	0.025994	22032	405.3	152.00
5	0.032387	20093	469.4	176.04
6	0.038737	17971	512.1	192.03
7	0.045046	15757	532.6	199.72
8	0.051313	13538	531.9	199.48
9	0.057539	11394	512.5	192.18
10	0.063725	9388	477.7	179.13
11	0.069869	7570	431.5	161.83
12	0.075974	5971	378.4	141.90
13	0.082038	4605	322.3	120.86
14	0.088063	3470	266.8	100.05
15	0.094048	2554	214.7	80.52
16	0.099994	1835	168.0	63.01
17	0.105900	1286	127.8	47.94
18	0.111768	878	94.5	35.45
19	0.117598	585	68.0	25.48

TABLE D.10

ESTIMATED SUBSURFACE SOIL REMEDIATION LEVEL
MEDLEY FARM SITE
COMPOUND - 1,1,2-TRICHLOROETHANE

Qp =	900 gal/day		Qgw =	1500 gal/day
I =	0.305 m/yr		D =	15 meters
Koc =	56		d =	6 meters
R =	6.32		foc =	0.01
1/T =	0.016086		Kd =	0.56 l/kg
Vol. moist. content =	0.2		MCL =	5 ug/l
Bulk density =	1.9			

Time (years)	C/Co	Cs (ug/kg)	Cw (ug/l)	Cgw (ug/l)
0	0	160	0.0	0.00
1	0.015957	152	4.6	1.71
2	0.031660	138	8.6	3.23
3	0.047113	118	11.6	4.35
4	0.062319	95	13.1	4.93
5	0.077282	73	13.2	4.94
6	0.092007	52	11.9	4.48
7	0.106496	35	9.9	3.70
8	0.120755	21	7.4	2.79
9	0.134786	12	5.1	1.92
10	0.148592	6	3.2	1.21
11	0.162179	3	1.8	0.69
12	0.175549	1	0.9	0.35
13	0.188705	0	0.4	0.16
14	0.201652	0	0.2	0.07
15	0.214392	0	0.1	0.02
16	0.226928	0	0.0	0.01
17	0.239265	0	0.0	0.00
18	0.251404	0	0.0	0.00
19	0.263350	0	0.0	0.00

TABLE D.11

ESTIMATED SUBSURFACE SOIL REMEDIATION LEVEL
MEDLEY FARM SITE
COMPOUND - TETRACHLOROETHENE

Qp = 900 gal/day	Qgw = 1500 gal/day
I = 0.305 m/yr	D = 15 meters
Koc = 364	d = 6 meters
R = 35.58	foc = 0.01
1/T = 0.002857	Kd = 3.64 l/kg
Vol. moist. content = 0.2	MCL = 5 ug/l
Bulk density = 1.9	

Time (years)	C/Co	Cs (ug/kg)	Cw (ug/l)	Cgw (ug/l)
0	0	1600	0.0	0.00
2	0.005698	1576	2.5	0.94
4	0.011364	1530	4.9	1.85
6	0.016998	1463	7.1	2.68
8	0.022599	1377	9.1	3.41
10	0.028169	1275	10.7	4.00
12	0.033707	1163	11.8	4.43
14	0.039214	1043	12.5	4.70
16	0.044689	921	12.8	4.80
18	0.050133	799	12.7	4.75
20	0.055545	681	12.2	4.57
22	0.060927	571	11.4	4.28
24	0.066279	470	10.4	3.90
26	0.071600	381	9.3	3.47
28	0.076890	302	8.0	3.01
30	0.082150	236	6.8	2.56
32	0.087381	180	5.7	2.12
34	0.092581	135	4.6	1.72
36	0.097752	99	3.6	1.36
38	0.102894	72	2.8	1.05

TABLE D.12

ESTIMATED SUBSURFACE SOIL REMEDIATION LEVEL
MEDLEY FARM SITE
COMPOUND - METHYLENE CHLORIDE

Qp =   900 gal/day   Qgw =   1500 gal/day
 I = 0.305 m/yr   D =   15 meters
Koc =   8.8   d =   6 meters
 R =   1.836   foc = 0.01
1/T =   0.055374   Kd = 0.088 l/kg
Vol. moist. content = 0.2   MCL =   5 ug/l
Bulk density =   1.9

Time (years)	C/Co	Cs (ug/kg)	Cw (ug/l)	Cgw (ug/l)
0	0	40	0.0	0.00
0.2	0.011013	38	5.0	1.88
0.4	0.021906	33	9.4	3.51
0.6	0.032678	27	12.3	4.60
0.8	0.043332	20	13.3	4.98
1	0.053868	14	12.5	4.69
1.2	0.064289	9	10.4	3.89
1.4	0.074594	5	7.7	2.87
1.6	0.084786	3	5.0	1.87
1.8	0.094866	1	2.9	1.08
2	0.104835	0	1.4	0.54
2.2	0.114694	0	0.6	0.23
2.4	0.124445	0	0.2	0.08
2.6	0.134088	0	0.1	0.02
2.8	0.143625	0	0.0	0.01
3	0.153057	0	0.0	0.00
3.2	0.162385	0	0.0	0.00
3.4	0.171610	0	0.0	0.00
3.6	0.180733	0	0.0	0.00
3.8	0.189757	0	0.0	0.00

TABLE D.13

ESTIMATED SUBSURFACE SOIL REMEDIATION LEVEL
MEDLEY FARM SITE
COMPOUND - CHLOROFORM

Qp =   900 gal/day   Qgw =   1500 gal/day
 I = 0.305 m/yr   D =   15 meters
Koc =   31   d =   6 meters
R   =   3.945   foc = 0.01
1/T =   0.025771   Kd =   0.31 l/kg
Vol. moist. content = 0.2 MCL =   100 ug/l
Bulk density =   1.9

Time (years)	C/Co	Cs (ug/kg)	Cw (ug/l)	Cgw (ug/l)
0	0	3000	0.0	0.00
0.25	0.006422	2935	62.1	23.31
0.5	0.012802	2809	121.2	45.46
0.75	0.019142	2627	173.4	65.04
1	0.025441	2400	215.6	80.84
1.25	0.031700	2141	245.4	92.04
1.5	0.037918	1864	261.9	98.22
1.75	0.044097	1582	265.2	99.43
2	0.050236	1309	256.4	96.17
2.25	0.056335	1055	237.9	89.23
2.5	0.062395	827	212.4	79.64
2.75	0.068417	631	182.6	68.48
3	0.074399	468	151.5	56.79
3.25	0.080344	336	121.2	45.45
3.5	0.086250	235	93.6	35.11
3.75	0.092118	159	69.8	26.17
4	0.097948	104	50.2	18.82
4.25	0.103741	66	34.8	13.05
4.5	0.109497	40	23.3	8.72
4.75	0.115216	24	15.0	5.61

TABLE D.14

ESTIMATED SUBSURFACE SOIL REMEDIATION LEVEL
MEDLEY FARM SITE
COMPOUND - ACETONE

Qp =   900 gal/day   Qgw =   1500 gal/day
 I = 0.305 m/yr   D   =   15 meters
Koc =   2.2   d   =   6 meters
R   =   1.209   foc =   0.01
1/T =   0.084091   Kd =   0.022 l/kg
Vol. moist. content = 0.2 MCL =   3500 ug/l
Bulk density =   1.9

Time (years)	C/Co	Cs (ug/kg)	Cw (ug/l)	Cgw (ug/l)
0	0	12000	0.0	0.00
0.1	0.008373	10541	4567.6	1712.84
0.2	0.016677	7977	7990.6	2996.49
0.3	0.024911	5067	9032.8	3387.29
0.4	0.033077	2602	7617.8	2856.69
0.5	0.041174	1020	4869.8	1826.19
0.6	0.049203	276	2280.9	855.35
0.7	0.057165	41	716.4	268.65
0.8	0.065060	1	121.3	45.47
0.9	0.072889	0	3.7	1.38
1	0.080652	0	-0.4	-0.14
1.1	0.088351	0	0.1	0.03
1.2	0.095985	0	0.0	-0.01
1.3	0.103555	0	0.0	0.01
1.4	0.111062	0	0.0	0.00
1.5	0.118506	0	0.0	0.00

TABLE D.15

ESTIMATED SUBSURFACE SOIL REMEDIATION LEVEL
MEDLEY FARM SITE
COMPOUND - ACENAPHTHALENE

Qp	=	900 gal/day	Qgw	=	1500 gal/day
I	=	0.305 m/yr	D	=	15 meters
Koc	=	4600	d	=	6 meters
R	=	438	foc	=	0.01
1/T	=	0.000232	Kd	=	46 l/kg
Vol. moist. content =		0.2	MCL	=	2100 ug/l
Bulk density =		1.9			

Time (years)	C/Co	Cs (ug/kg)	Cw (ug/l)	Cgw (ug/l)
0	0	13700000	0.0	0.00
10	0.002318	13620318	690.5	258.94
20	0.004631	13461882	1371.4	514.27
30	0.006939	13226992	2030.8	761.54
40	0.009241	12919271	2657.4	996.52
50	0.011538	12543567	3240.7	1215.26
60	0.013830	12105834	3771.4	1414.26
70	0.016116	11612967	4241.5	1590.55
80	0.018397	11072623	4644.7	1741.75
90	0.020673	10493020	4976.4	1866.13
100	0.022944	9882728	5233.8	1962.67
110	0.025209	9250452	5416.1	2031.02
120	0.027469	8604826	5524.0	2071.51
130	0.029724	7954213	5560.3	2085.10
140	0.031973	7306530	5528.8	2073.32
150	0.034218	6669090	5435.1	2038.18
160	0.036457	6048473	5285.6	1982.10
170	0.038691	5450431	5087.5	1907.80
180	0.040920	4879819	4848.5	1818.19
190	0.043143	4340564	4576.8	1716.30
200	0.045362	3835655	4280.4	1605.14
210	0.047575	3367169	3967.0	1487.63
220	0.049783	2936321	3644.1	1366.55
230	0.051986	2543523	3318.5	1244.42
240	0.054184	2188478	2996.1	1123.53
250	0.056377	1870264	2682.2	1005.82
260	0.058565	1587442	2381.1	892.93
270	0.060747	1338155	2096.4	786.14
280	0.062925	1120233	1830.5	686.45
290	0.065097	931284	1585.3	594.50
300	0.067265	768789	1361.8	510.68

TABLE D.16

ESTIMATED SUBSURFACE SOIL REMEDIATION LEVEL
MEDLEY FARM SITE
COMPOUND - BENZOIC ACID

Qp =   900 gal/day   Qgw =   1500 gal/day
 I = 0.305 m/yr   D =   15 meters
Koc =   65   d =   6 meters
 R =   7.175   foc =   0.01
1/T =   0.014169   Kd =   0.65 l/kg
Vol. moist. content = 0.2 MCL =   140000 ug/l
Bulk density =   1.9

Time (years)	C/Co	Cs (ug/kg)	Cw (ug/l)	Cgw (ug/l)
0	0	5500000	0.0	0.00
1	0.014069	5273617	119050.9	44644.10
2	0.027941	4839486	226695.4	85010.76
3	0.041617	4241898	309860.3	116197.60
4	0.055101	3543502	359595.4	134848.27
5	0.068396	2814239	372865.7	139824.62
6	0.081503	2119224	352878.3	132329.37
7	0.094426	1508625	307863.4	115448.79
8	0.107167	1011857	248732.1	93274.55
9	0.119729	637020	186383.5	69893.81
10	0.132114	374819	129476.4	48553.64
11	0.144325	205113	83224.4	31209.17
12	0.156364	103802	49342.2	18503.33
13	0.168234	48259	26866.3	10074.86
14	0.179936	20450	13359.3	5009.75
15	0.191474	7824	6024.0	2259.01
16	0.202850	2671	2441.7	915.63
17	0.214066	802	879.8	329.91
18	0.225124	208	277.8	104.18
19	0.236026	45	75.5	28.30

TABLE D.17

ESTIMATED SUBSURFACE SOIL REMEDIATION LEVEL
MEDLEY FARM SITE
COMPOUND - 1,4-DICHLOROBENZENE

Qp =	900 gal/day	Qgw =	1500 gal/day	
I =	0.305 m/yr	D =	15 meters	
Koc =	1700	d =	6 meters	
R =	162.5	foc =	0.01	
1/T =	0.000625	Kd =	17 l/kg	
Vol. moist. content =	0.2	MCL =	75 ug/l	
Bulk density =	1.9			

Time (years)	C/Co	Cs (ug/kg)	Cw (ug/l)	Cgw (ug/l)
0	0	150000	0.0	0.00
5	0.003123	148820	27.6	10.33
10	0.006236	146478	54.6	20.47
15	0.009340	143020	80.5	30.18
20	0.012434	138518	104.6	39.23
25	0.015519	133068	126.5	47.42
30	0.018594	126785	145.5	54.58
35	0.021659	119802	161.5	60.58
40	0.024715	112260	174.2	65.31
45	0.027761	104310	183.3	68.75
50	0.030797	96102	189.0	70.86
55	0.033824	87783	191.2	71.71
60	0.036842	79494	190.2	71.34
65	0.039850	71362	186.3	69.88
70	0.042849	63501	179.9	67.45
75	0.045839	56005	171.2	64.21
80	0.048819	48954	160.8	60.31
85	0.051790	42405	149.1	55.93
90	0.054751	36399	136.6	51.22
95	0.057704	30957	123.6	46.33
100	0.060647	26085	110.4	41.41
105	0.063581	21775	97.6	36.58
110	0.066505	18005	85.2	31.94
115	0.069421	14746	73.5	27.57
120	0.072327	11961	62.7	23.53
125	0.075225	9608	52.9	19.85

TABLE D.18

ESTIMATED SUBSURFACE SOIL REMEDIATION LEVEL
MEDLEY FARM SITE
COMPOUND - DIETHYLPHTHALATE

Qp	=	900 gal/day	Qgw =	1500 gal/day
I	=	0.305 m/yr	D =	15 meters
Koc	=	142	d =	6 meters
R	=	14.49	foc =	0.01
1/T	=	0.007016	Kd =	1.42 l/kg
Vol. moist. content =		0.2	MCL =	28000 ug/l
Bulk density =		1.9		

Time (years)	C/Co	Cs (ug/kg)	Cw (ug/l)	Cgw (ug/l)
0	0	3300000	0.0	0.00
1	0.006991	3237824	16248.5	6093.19
2	0.013934	3115816	31773.2	11914.97
3	0.020829	2939700	45703.8	17138.92
4	0.027675	2718151	57293.4	21485.03
5	0.034473	2462086	65988.7	24745.77
6	0.041224	2183755	71477.1	26803.91
7	0.047927	1895744	73705.9	27639.72
8	0.054584	1610001	72871.9	27326.96
9	0.061194	1336993	69382.6	26018.47
10	0.067758	1085088	63797.6	23924.10
11	0.074276	860201	56758.1	21284.30
12	0.080748	665716	48915.7	18343.40
13	0.087176	502659	40869.4	15326.01
14	0.093558	370070	33118.3	12419.35
15	0.099896	265482	26034.1	9762.81
16	0.106189	185450	19853.1	7444.90
17	0.112438	126051	14684.3	5506.63
18	0.118644	83302	10531.8	3949.44
19	0.124806	53481	7321.6	2745.59

TABLE D.19

ESTIMATED SUBSURFACE SOIL REMEDIATION LEVEL
MEDLEY FARM SITE
COMPOUND - BIS(2-ETHYLHEXYL)PHTHALATE

Qp   =   900 gal/day   Qgw =   1500 gal/day
 I   = 0.305 m/yr   D   =   15 meters
Koc =   10000   d   =   6 meters
R   =   951   foc =   0.01
1/T =   0.000106   Kd =   100 l/kg
Vol. moist. content = 0.2   MCL =   4 ug/l
Bulk density =   1.9

Time (years)	C/Co	Cs (ug/kg)	Cw (ug/l)	Cgw (ug/l)
0	0	84000	0.0	0.00
10	0.001068	83775	0.9	0.34
20	0.002135	83327	1.8	0.67
30	0.003202	82658	2.7	1.00
40	0.004267	81774	3.5	1.32
50	0.005330	80680	4.4	1.63
60	0.006393	79385	5.2	1.93
70	0.007455	77898	5.9	2.22
80	0.008515	76231	6.6	2.49
90	0.009575	74395	7.3	2.74
100	0.010633	72405	7.9	2.97
110	0.011690	70274	8.5	3.17
120	0.012746	68018	9.0	3.36
130	0.013801	65652	9.4	3.52
140	0.014855	63193	9.8	3.66
150	0.015907	60657	10.1	3.77
160	0.016959	58060	10.3	3.86
170	0.018009	55420	10.5	3.92
180	0.019058	52751	10.6	3.96
190	0.020107	50069	10.6	3.98
200	0.021154	47390	10.6	3.97
210	0.022199	44727	10.5	3.95
220	0.023244	42095	10.4	3.90
230	0.024288	39505	10.2	3.83
240	0.025330	36968	10.0	3.75
250	0.026372	34495	9.7	3.66
260	0.027412	32096	9.5	3.55
270	0.028451	29777	9.1	3.42
280	0.029489	27547	8.8	3.29
290	0.030526	25409	8.4	3.15
300	0.031562	23370	8.0	3.01

TABLE D.20

ESTIMATED SUBSURFACE SOIL REMEDIATION LEVEL
MEDLEY FARM SITE
COMPOUND - PHENOL

```
Qp  =    900 gal/day      Qgw =    1500 gal/day
 I  = 0.305 m/yr           D  =      15 meters
Koc =         14.2         d  =       6 meters
R   =        2.349        foc =    0.01
1/T =     0.043280        Kd  =   0.142 l/kg
Vol. moist. content = 0.2  MCL = 21000 ug/l
Bulk density =       1.9
```

Time (years)	C/Co	Cs (ug/kg)	Cw (ug/l)	Cgw (ug/l)
0	0	250000	0.0	0.00
0.25	0.010761	238224	18947.0	7105.11
0.5	0.021407	215782	35914.7	13468.02
0.75	0.031939	185290	48534.9	18200.60
1	0.042357	150380	55270.8	20726.55
1.25	0.052663	114963	55771.4	20914.26
1.5	0.062858	82473	50890.4	19083.90
1.75	0.072944	55280	42365.4	15887.04
2	0.082920	34449	32280.7	12105.25
2.25	0.092790	19845	22510.9	8441.60
2.5	0.102553	10498	14332.4	5374.67
2.75	0.112211	5058	8295.5	3110.80
3	0.121766	2199	4337.7	1626.63

TABLE D.21

ESTIMATED SUBSURFACE SOIL REMEDIATION LEVEL
MEDLEY FARM SITE
COMPOUND - 1,2,4-TRICHLOROBENZENE

Qp =	900 gal/day	Qgw =	1500 gal/day	
I =	0.305 m/yr	D =	15 meters	
Koc =	9200	d =	6 meters	
R =	875	foc =	0.01	
1/T =	0.000116	Kd =	92 l/kg	
Vol. moist. content =	0.2	MCL =	9 ug/l	
Bulk density =	1.9			

Time (years)	C/Co	Cs (ug/kg)	Cw (ug/l)	Cgw (ug/l)
0	0	160000	0.0	0.00
10	0.001161	159535	2.0	0.76
20	0.002321	158607	4.0	1.51
30	0.003479	157223	6.0	2.25
40	0.004636	155394	7.9	2.97
50	0.005792	153135	9.8	3.67
60	0.006947	150463	11.6	4.34
70	0.008100	147400	13.2	4.97
80	0.009252	143971	14.8	5.56
90	0.010402	140203	16.3	6.10
100	0.011551	136125	17.6	6.60
110	0.012699	131771	18.8	7.05
120	0.013846	127172	19.8	7.44
130	0.014991	122365	20.7	7.77
140	0.016135	117383	21.5	8.05
150	0.017277	112262	22.0	8.27
160	0.018418	107039	22.5	8.43
170	0.019558	101747	22.8	8.53
180	0.020697	96421	22.9	8.58
190	0.021834	91094	22.9	8.58
200	0.022970	85795	22.7	8.53
210	0.024104	80556	22.5	8.43
220	0.025237	75402	22.1	8.29
230	0.026369	70359	21.6	8.10
240	0.027500	65448	21.0	7.89
250	0.028629	60690	20.4	7.64
260	0.029757	56101	19.6	7.36
270	0.030884	51696	18.8	7.06
280	0.032009	47487	18.0	6.75
290	0.033133	43482	17.1	6.41
300	0.034256	39688	16.2	6.07

TABLE D.22

ESTIMATED SUBSURFACE SOIL REMEDIATION LEVEL
MEDLEY FARM SITE
COMPOUND - PCBs

Qp =	900 gal/day		Qgw =	1500 gal/day
I =	0.305 m/yr		D =	15 meters
Koc =	530000		d =	6 meters
R =	50351		foc =	0.01
1/T =	0.000002		Kd =	5300 l/kg
Vol. moist. content =	0.2		MCL =	0.5 ug/l
Bulk density =	1.9			

Time (years)	C/Co	Cs (ug/kg)	Cw (ug/l)	Cgw (ug/l)
0	0	400000	0.0	0.00
1000	0.002017	397981	0.2	0.06
2000	0.004030	393963	0.3	0.11
3000	0.006039	387997	0.4	0.17
4000	0.008044	380162	0.6	0.22
5000	0.010045	370567	0.7	0.27
6000	0.012041	359343	0.8	0.32
7000	0.014034	346645	1.0	0.36
8000	0.016023	332647	1.0	0.39
9000	0.018008	317534	1.1	0.42
10000	0.019989	301505	1.2	0.45
11000	0.021965	284763	1.2	0.47
12000	0.023938	267513	1.3	0.48
13000	0.025907	249958	1.3	0.49
14000	0.027872	232293	1.3	0.49
15000	0.029833	214703	1.3	0.49
16000	0.031790	197362	1.3	0.48
17000	0.033743	180425	1.3	0.47
18000	0.035692	164031	1.2	0.46
19000	0.037637	148299	1.2	0.44
20000	0.039578	133327	1.1	0.42
21000	0.041515	119193	1.0	0.39
22000	0.043449	105956	1.0	0.37
23000	0.045378	93654	0.9	0.34
24000	0.047304	82308	0.8	0.31
25000	0.049226	71920	0.8	0.29
26000	0.051143	62481	0.7	0.26
27000	0.053057	53965	0.6	0.23
28000	0.054967	46337	0.6	0.21
29000	0.056874	39554	0.5	0.19
30000	0.058776	33564	0.4	0.16

APPENDIX E

PROTECTIVE LEVELS FOR SITE CHEMICALS

GROUND WATER

Six chemicals present in the ground water at the Medley Farm Site lack established water quality criteria for consideration in development of remediation alternatives. Target concentrations are required for application at the point of exposure identified in the baseline risk assessment, i.e., ground-water ingestion. It therefore was necessary to develop health-based ground-water levels for these chemicals. The preliminary pollutant limit value (PPLV) concept was used to obtain risk-based levels protective of human health.

The preliminary pollutant limit value concept has been used extensively, primarily by the U.S. Army to help establish cleanup levels for soil and water, and goals for preventing undue exposure to toxic chemicals from uncontrolled hazardous waste sites. The methods involved are described in numerous agency reports and in at least one peer-reviewed journal (Rosenblatt et al., 1986). The application of this concept to the Medley Farm Site is presented below.

Development of Preliminary Pollutant Limit Values

Preliminary pollutant limit values (PPLVs) were calculated using the following standard parameter values for chronic human exposure via the ground-water ingestion pathway: 70 kg adult body weight and an adult drinking water consumption rate of 2 liters per day (U.S. EPA, 1990a). Site-specific parameter values used here (exposure frequency, exposure duration, and averaging time) are taken from the Risk Assessment for the Site (Section 3.3.1 of this Feasibility Study). Estimates of acceptable daily dose (D_T) were derived form the best available toxicological data, as explained below for each chemical.

The PPLV for ingestion of ground water is calculated by:

$$\text{Ground Water PPLV} = \frac{D_T \times \text{body weight} \times \text{averaging time}}{\text{daily water intake} \times \text{exposure frequency} \times \text{exposure duration}}$$

E-1

Derivation of the respective PPLVs are presented below for each chemical and summarized in Table E.1.

1,1-Dichloroethane

Although 1,1-dichloroethane has been classified as Group C (possible human carcinogen) by the EPA Carcinogen Assessment Group, the slope factor has been withdrawn pending review (U.S. EPA, 1990c). The oral reference dose for noncarcinogenic effects (RfD) of 0.1 mg/kg/day (U.S. EPA, 1990b) is therefore used as the acceptable D_T for 1,1-dichloroethane.

The health-based ground-water level, or PPLV, for 1,1-dichloroethane is calculated by:

$$\text{Ground Water PPLV} = \frac{0.1 \text{ mg/kg/day} \times 70 \text{ kg} \times 10950 \text{ days}}{2 \text{ liters} \times 365 \text{ days/yr} \times 30 \text{ years}}$$

$$= 3.5 \text{ mg/l}$$

Acenaphthalene

The only human health standard available for use as a D_T for acenaphthalene is the oral RfD of 0.06 mg/kg/day, verified by the EPA RfD Work Group (U.S. EPA, 1990b).

The health-based ground-water level for acenaphthalene is therefore calculated as follows:

$$\text{Ground Water PPLV} = \frac{0.06 \text{ mg/kg/day} \times 70 \text{ kg} \times 10950 \text{ days}}{2 \text{ liters} \times 365 \text{ days/yr} \times 30 \text{ years}}$$

$$= 2.1 \text{ mg/l}$$

E-2

Acetone

The EPA Carcinogen Assessment Group has classified acetone as a group D substance, i.e., not classifiable as to human carcinogenicity. The oral RfD of 0.1 mg/kg/day (U.S. EPA, 1990c) is therefore used a the acceptable daily dose for acetone.

The health-based ground-water level for acetone is calculated as follows:

Ground Water PPLV $=$ $\dfrac{0.1 \text{ mg/kg/day} \times 70 \text{ kg} \times 10950 \text{ days}}{2 \text{ liters} \times 365 \text{ days/yr} \times 30 \text{ years}}$

$=$ 3.5 mg/l

Benzoic Acid

Benzoic acid has been classified as a group D substance by the EPA Carcinogen Assessment Group. Therefore, the oral RfD of 4 mg/kg/day (U.S. EPa, 1990c) is used as the acceptable daily dose for benzoic acid.

The health-based ground-water level for benzoic acid is calculated as follows:

Ground Water PPLV $=$ $\dfrac{4 \text{ mg/kg/day} \times 70 \text{ kg} \times 10950 \text{ days}}{2 \text{ liters} \times 365 \text{ days/yr} \times 30 \text{ years}}$

$=$ 140 mg/l

Diethylphthalate

Diethylphthalate, like acetone and benzoic acid, has been classified group D, not classifiable as to human carcinogenicity. The acceptable daily dose is therefore taken to be the oral RfD, which is 0.8 mg/kg/day (U.S. EPA, 1990c).

The health-based ground-water level for diethylphthalate is calculated by:

Ground Water PPLV $=$ $\dfrac{0.8 \text{ mg/kg/day} \times 70 \text{ kg} \times 10950 \text{ days}}{2 \text{ liters} \times 365 \text{ days/yr} \times 30 \text{ years}}$

$=$ 28 mg/l

Phenol

Phenol is also classified group D and the oral RfD of 0.6 mg/kg/day (U.S. EPA, 1990c) is used as an acceptable daily dose.

Therefore:

Ground Water PPLV $=$ $\dfrac{0.6 \text{ mg/kg/day} \times 70 \text{ kg} \times 10950 \text{ days}}{2 \text{ liters} \times 365 \text{ days/yr} \times 30 \text{ years}}$

$=$ 21 mg/l

SOIL

The preliminary pollutant limit value concept was also used to develop a health-based level for PCBs in soil at the Medley Farm Site. PPLVs were calculated using the standard and site-specific parameter values for human exposure that were used for the Risk Assessment in Section 3.3.1 of this Feasibility Study. Potentially significant routes of entry for PCBs in surface soil are ingestion and dermal absorption. A single pathway preliminary pollutant limit value (SPPPLV) is calculated for both of these routes of entry. The soil PPLV is then calculated as $\dfrac{1}{\Sigma \dfrac{1}{\text{SPPPLV}}}$, after Rosenblatt et al. (1982).

An acceptable daily dose for PCBs has been derived based on a cancer risk of 10^{-6} and a cancer slope factor of 7.7/mg/kg/day (U.S. EPA, 1990c). Thus,

$$D_T = \frac{1}{7.7} \times 10^{-6}$$

$$= 1.3 \times 10^{-7} \text{ mg/kg/day}$$

The SPPPLV for soil ingestion is calculated as follows:

$$\text{SPPPLV for Ingestion} = \frac{D_T \times BW_c \times AT}{IR_c \times FI \times ER_c \times ED_c \times CF} + \frac{D_T \times BW_a \times AT}{IR_a \times FI \times ER_a \times ED_a \times CF}$$

$$= \frac{1.3E\text{-}7 \text{ mg/kg/d} \times 16 \text{ kg} \times 25550d}{0.2 \text{ g/d} \times .17 \times 24 \text{ d/yr} \times 6 \text{ yr} \times 10^{-3} \text{ kg/g}} + \frac{1.3E\text{-}7 \text{ mg/kg/d} \times 70 \text{ kg} \times 25550d}{0.1 \text{ g/d} \times .17 \times 24 \text{ d/yr} \times 15 \text{ yr} \times 10^{-3} \text{ kg/g}}$$

$$= 1.085E+1 + 2.374E+1$$

$$= 34.6 \text{ mg/kg}$$

The SPPPLV for dermal absorption of soil is calculated as follows:

$$\text{SPPPLV for Dermal Absorption} = \frac{D_T \times BW_c \times AT}{SA_c \times AF \times ABS_c \times EF_c \times ED_c \times CF} + \frac{D_T \times BW_a \times AT}{SA_a \times AF \times ABS_a \times EF_a \times ED_a \times CF}$$

$$= \frac{1.3 \text{ E-7 mg/kg} \times 37 \text{ kg} \times 25550d}{4046 \text{ cm}^2/\text{event} \times 2.11 \text{ mg/cm}^2 \times 0.036 \times 24 \text{ d/yr} \times 15 \text{ yr} \times 10^{-6} \text{ kg/mg}}$$

$$+ \frac{1.3 \text{ E-7 mg/kg} \times 70 \text{ kg} \times 25550d}{3160 \text{ cm}^2/\text{event} \times 2.11 \text{ mg/cm}^2 \times 0.018 \times 24 \text{ d/yr} \times 15 \text{ yr} \times 10^{-6} \text{ kg/mg}}$$

$$= 1.111E+0 + 5.381E+0$$

$$= 6.5 \text{ mg/kg}$$

The soil PPLV for the ingestion and dermal absorption paths are therefore:

$$\text{Soil PPLV} = \frac{1}{\frac{1}{34.6} + \frac{1}{6.5}}$$

$$= 5.5 \text{ mg/kg}$$

TABLE E.1

HEALTH BASED LEVELS

Compound	PPLV
Ground Water	(mg/l)
1,1-Dichloroethane	3.5
Acenaphthalene	2.1
Acetone	3.5
Benzoic Acid	140.0
Diethylphthalate	28.0
Phenol	21.0
Soil	(mg/kg)
PCBs	5.5

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APPENDIX F

AIR IMPACTS ANALYSIS

MEDLEY FARM SITE

AIR STRIPPER EMISSIONS CALCULATIONS REGULATORY REQUIREMENTS

The total volatile organic compound (VOC) emissions from the groundwater air stripper are estimated to be a maximum of 77 pounds per month (Table 4.6). The estimated levels represent the maximum emissions that could occur, with the emission rate steadily declining form startup until the cleanup is completed. Five of the Site VOCs are considered air toxics by South Carolina: 1,2-dichloroethane; trichloroethene; tetrachloroethene; methylene chloride; and chloroform. The maximum air toxics emissions for these compounds would be approximately 15 pounds per month.

The emissions rates given in Table 4.6 are based on the highest ground water concentrations observed anywhere at the Site. Actual ground water extraction would occur across a distributed front and influent concentrations would be significantly lower than maximum individual values. Actual VOC emission rates from an air stripper would also be significantly less. Maximum values are used here to provide a conservative estimate of potential ambient air concentrations.

South Carolina Air Pollution Control Regulation No. 62.1, Section II, F.2.g. states that "Sources with an uncontrolled particulate matter emission rate of less than 1 pound per hour and/or uncontrolled VOC emission rate of less than 1000 pounds per month may not require permits. However, source information needs to be submitted to the Department and a determination on the need for permits will be made." Additionally, South Carolina Department of Health and Environmental Control (DHEC) policy on toxic air pollutants requires sources to submit data on toxic air emissions regardless of emission rate. The toxic air emissions data will be used in an air dispersion model to estimate ambient air concentration of the toxic compounds at the property boundary and determine if the emissions are acceptable. The air emissions information is typically submitted using completed air permit application forms attached to a cover letter requesting a determination concerning the need for an air permit and the acceptability of the toxic air emissions. To

expedite the determination, the air toxics modeling and analysis can be performed by the source and attached to the permit application package.

The estimated ambient air concentrations at the Medley property line from operation of an air stripper at the Site are presented in Table F.1. A review of the emission estimates indicates that only one toxic air pollutant, 1,2-dichloroethane (1,2-DCA) requires evaluation. Trichloroethene, tetrachloroethene, methylene chloride, and chloroform will be emitted from the air stripper in concentrations well below the acceptable ambient limits. 1,2-DCA will be emitted from the stripper at a concentration of 1550 micrograms per cubic meter and the acceptable ambient limit is 200 micrograms per cubic meter. A screening evaluation of the 1,2-DCA emissions was conducted using the SCREEN air model to evaluate the ambient impacts. Other air toxics impacts were calculated based on the results of the 1,2-DCA modeling. The terrain was judged to be simple because the stripper emissions release height would be above the surrounding terrain. Additionally, downwash analysis was not necessary because there are no buildings in proximity to the proposed stripper site. The model indicate that the maximum ambient concentration that will result is 0.66 micrograms/cubic meter for a 1-hr average at 120 meters from the air stripper (the approximate distance to the property line). This translates to an approximate 24-hr concentration of 0.26 micrograms/cubic meter which is well below the acceptable ambient limit of 200 micrograms/cubic meter. Therefore, air toxics emissions would not pose a significant risk to human health and emissions control would not be required.

SCREENING AIR DISPERSION MODELING

The purpose of this summary is to provide a brief explanation of the dispersion modeling performed to screen the impact of potential toxic air pollutants at the Medley Farm Site. Screening dispersion modeling was carried out to estimate worst-case potential ground-level concentrations at the facility property lines for 1,2-dichloroethane (1,2-DCA) which would be emitted from the air stripping operations.

COMPOUND	GROUNDWATER CONCENTRATION (ug/l)	VOC COMPOUND (yes or no)	S.C AIR TOXIC (yes or no)	ACCEPTABLE AMBIENT LIMIT (ug/cu. m) 24-hour	MODELED AMBIENT CONCENTRATION (ug/cu. m) 1-hour	MODELED AMBIENT CONCENTRATION (ug/cu. m) 24-hour	BELOW ACCEPTABLE AMBIENT LIMIT? (yes or no)
1,1-DICHLOROETHANE	120	YES	NO				
1,1-DICHLOROETHENE	2,200	YES	NO				
1,2-DICHLOROETHENE (total)	31	YES	NO				
1,2-DICHLOROETHANE	290	NO	YES	200	0.66	0.26	YES
1,1,1-TRICHLOROETHANE	3,400	NO	NO				
TRICHLOROETHENE	720	YES	YES	6,750	1.65	0.66	YES
TETRACHLOROETHENE	200	YES	YES	3,350	0.47	0.19	YES
1,1,2-TRICHLOROETHANE	18	YES	NO				
METHYLENE CHLORIDE	110	NO	YES	8,750	0.25	0.10	YES
CHLOROFORM	10	NO	YES	250	0.23	0.09	YES

NOTES:
1. MODELED AMBIENT CONCENTRATIONS ARE BASED ON MAXIMUM INDIVIDUAL GROUND WATER CONCENTRATIONS AND THE MAXIMUM PROJECTED EXTRACTION FLOW RATE. ACTUAL AMBIENT CONCENTRATIONS WOULD BE SIGNIFICANTLY LOWER.
2. MODELED CONCENTRATIONS ARE MAXIMUM GROUND LEVEL CONCENTRATIONS AT 120 METERS, THE APPROXIMATE DISTANCE TO THE CLOSEST PROPERTY LINE.
3. 24-HOUR CONCENTRATIONS ARE CALCULATED BY USING A FACTOR OF 0.4 TIMES THE MODELED 1-HOUR CONCENTRATION.

The ability to predict ambient concentrations of pollutants being discharged from industrial processes is based on the accuracy of the mathematical models that have been developed to simulate the transport and dispersion of pollutants in the atmosphere. The atmospheric dispersion of emissions from vents and stacks depends on many factors including the physical and chemical nature of the emissions, the meteorological characteristics of the environment, the location of the stack in relation to obstructions to air motion, and the nature of the terrain downwind from the stack. Many different classes of mathematical models (such as Gaussian, puff, numerical, statistical, etc.) are available to be used for a variety of specific applications. For the traditional Gaussian-based air dispersion models developed and recommended for use by the U.S. EPA (i.e., the "UNAMAP" series of models), two levels of sophistication are recommended in EPA guidelines. The first level, referred to as screening modeling, consists of general, relatively simple estimation techniques that provide conservative estimates of the air quality impact of a specific source. Usually, the screening level can provide estimates of maximum ground-level concentrations under worst-case conditions and how far downwind these maximum concentrations are likely to occur. Screening modeling may also be used to predict the maximum potential ground-level concentrations at specific receptors such as property lines. User manuals and guidelines are available from the U.S. EPA for the specific Gaussian-based models and the general methodology recommended for air dispersion modeling studies. ("Guideline of Air Quality Models (Revised)", July, 1986, NTIS No. PB86-245248; Supplement A, July, 1987, EPA-450/2-78-027R).

The air dispersion model used in this screening impact analysis is the EPA SCREEN model. The SCREEN model is currently proposed by the EPA as an air toxics screening model for evaluating the air quality impact of new stationary sources. The State of South Carolina generally accepts the SCREEN model for screening analysis in the preliminary evaluations of air toxic impacts related to new projects.

The SCREEN model is a Gaussian-based mathematical model adapted from the UNAMAP PTPLU model for use interactively on a PC. The current version 1.1 has been modified to include a cavity analysis and the latest Schulman-Scire and Huber-Snyder downwash algorithms.

In using the SCREEN model, a set of meteorological data is already available as a model option to represent worst case combinations of atmospheric stability and wind speed. An ambient temperature of 293 K and a mixing height of 5,000 meters were used in the modeling. This option is referred to as the "Full Meteorology" option.

In addition to the meteorological data, source emissions and exhaust data must be input to the model. These data include the specific exhaust characteristics such as volumetric flow rate, velocity, diameter, height, and temperature, but it also includes the dimensions of adjacent buildings in order for the model to account for plume downwash effects. Plume downwash as a result of wake effects is described further in "Industrial Source Complex (ISC) Dispersion Model Users Guide - Second Edition, Volume I", EPA-0450/4-88-002a, December 1987.

Receptors can be input to the SCREEN model at specific receptor locations, or they can be located in an fashion by the model. For this source, an automated distance array was chosen. In each case, the minimum receptor distance was the minimum distance to the property line as estimated by plant personnel.

Finally, other model parameters are selected to reflect the nature of the source setting (i.e., the dispersion characteristics of the atmosphere) and the desired averaging period. In this case, the rural setting was chosen for the facility. For screening modeling, an averaging period of one hour is used. A correction factor of 0.4 was used to convert the one-hour results to 24-hour impacts. The 24-hour impact was then compared to the South Carolina guidelines for 1,2-DCA.

The stack height exceeds the highest terrain in proximity to the proposed stripper site and therefore simple terrain characteristics were assumed.

```
*** SCREEN-1.1 MODEL RUN ***
*** VERSION DATED  88300 ***

 JLEY FARMS 1/2/91--1,2 DCA

SIMPLE TERRAIN INPUTS:
   SOURCE TYPE           =      POINT
   EMISSION RATE (G/S)   =      .7440E-03
   STACK HEIGHT (M)      =      8.60
   STK INSIDE DIAM (M)   =       .46
   STK EXIT VELOCITY (M/S)=      2.90
   STK GAS EXIT TEMP (K) =    283.00
   AMBIENT AIR TEMP (K)  =    293.00
   RECEPTOR HEIGHT (M)   =       .00
   IOPT (1=URB,2=RUR)    =      2
   BUILDING HEIGHT (M)   =       .00
   MIN HORIZ BLDG DIM (M) =      .00
   MAX HORIZ BLDG DIM (M) =      .00

TA > TS!!!  BUOY. FLUX SET = 0.0

BUOY. FLUX =       .00 M**4/S**3;  MOM. FLUX =      .46 M**4/S**2.

*** FULL METEOROLOGY ***

*********************************
*** SCREEN AUTOMATED DISTANCES ***
*********************************

*** TERRAIN HEIGHT OF   0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***
```

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
50.	.5112	1	1.0	1.0	320.0	12.6	14.4	7.3	NO
100.	.6193	3	1.0	1.0	320.0	12.6	12.5	7.5	NO
200.	.6011	4	1.0	1.0	320.0	12.6	15.6	8.6	NO
300.	.5761	5	1.0	1.0	5000.0	12.5	16.9	8.8	NO
400.	.5288	6	1.0	1.0	5000.0	12.2	14.7	7.1	NO
500.	.5536	6	1.0	1.0	5000.0	12.2	18.0	8.5	NO
600.	.5243	6	1.0	1.0	5000.0	12.2	21.3	9.8	NO
700.	.4768	6	1.0	1.0	5000.0	12.2	24.5	11.0	NO
800.	.4268	6	1.0	1.0	5000.0	12.2	27.7	12.0	NO
900.	.3816	6	1.0	1.0	5000.0	12.2	30.8	13.0	NO
1000.	.3420	6	1.0	1.0	5000.0	12.2	33.9	14.0	NO

```
MAXIMUM 1-HR CONCENTRATION AT OR BEYOND    50. M:
```

120.	.6576	3	1.0	1.0	320.0	12.6	14.9	8.9	NO

```
DWASH=    MEANS NO CALC MADE (CONC = 0.0)
DWASH=NO MEANS NO BUILDING DOWNWASH USED
DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
 ASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

***********************************************
*   SUMMARY OF TERRAIN HEIGHTS ENTERED FOR   *
*      SIMPLE ELEVATED TERRAIN PROCEDURE      *
```

```
************************************************

      TERRAIN          DISTANCE RANGE (M)
      HT (M)          MINIMUM     MAXIMUM
     -------          --------    --------
        0.              50.        1000.


      ***************************************
      *** SUMMARY OF SCREEN MODEL RESULTS ***
      ***************************************

CALCULATION         MAX CONC     DIST TO    TERRAIN
 PROCEDURE          (UG/M**3)    MAX (M)     HT (M)
---------------     ----------   -------    -------
SIMPLE TERRAIN        .6576        120.        0.


*******************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
*******************************************************
```

APPENDIX G

DETAILED COST ESTIMATES

MEDLEY FARM SITE

TABLE G.1
MEDLEY FARM SITE
GAFFNEY, SOUTH CAROLINA
ALTERNATIVE GWC-1A
NO ACTION (5-YEAR REVIEW OF REMEDY)

REMEDY REVIEW

EVERY 5 YEARS, $50,000 EACH

YEAR	PWF (5%)
5	0.7835
10	0.6139
15	0.4810
20	0.3769
25	0.2953
30	0.2314
	2.7820

PRESENT WORTH COSTS   139,100

TABLE G.2
MEDLEY FARM SITE
GAFFNEY, SOUTH CAROLINA
ALTERNATIVE GWC-1B
NO ACTION (LONG-TERM MONITORING)

3 10 0435

DESCRIPTION		COST ($)
CONSTRUCTION COSTS		
SITE WORK		5,000
SAPROLITE WELLS (2)		10,000
BEDROCK WELLS (2)		20,000
	SUBTOTAL –	35,000
MONITORING COSTS		
LABOR		6,000
TRAVEL & PER DIEM		1,000
SUPPLIES & SHIPPING		2,000
ANALYSES		5,000
HEALTH & SAFETY		1,000
REPORTING		5,000
	SUBTOTAL –	20,000
ANNUAL COSTS		
MONITORING (TWICE A YEAR)		40,000
PRESENT WORTH O&M COSTS (30 YRS @ 5% = 15.372 PWF)		614,880
FIVE-YEAR REVIEW OF REMEDY (FROM TABLE G.1)		139,100
TOTAL PRESENT WORTH COSTS		788,980

TABLE G.3
MEDLEY FARM SITE
GAFFNEY, SOUTH CAROLINA
ALTERNATIVE GWC-2A
GROUNDWATER EXTRACTION SYSTEM, 30 GPM

DESCRIPTION	UNITS	QUANTITY	UNIT PRICE ($)	TOTAL ($)
CONSTRUCTION COSTS				
EXTRACTION WELL CONSTRUCTION	LF	1,000	120	120,000
WELL HEAD EQUIPMENT/CONTROLS	EA	10	3,850	38,500
DISCHARGE PIPING; 1-INCH	LF	2,500	6.33	15,825
DISCHARGE PIPING; 2-INCH	LF	1,000	7.00	7,000
SEEDING	LS	1	1,000	1,000
ELECTRICAL CONDUIT, WIRE, FIXTURES	LS	1	80,000	80,000
MONITOR WELL CONSTRUCTION	LF	450	100	45,000
DATA AQUISITION SYSTEM	LS	1	95,000	95,000
			SUBTOTAL –	402,325

FACTORED COSTS				
HEALTH & SAFETY	1	% OF CONSTRUCTION COST		4,023
BONDS & INSURANCE	1	% OF CONSTRUCTION COST		4,023
CONTINGENCY	10	% OF CONSTRUCTION COST		40,233
ENG/CONST. MANAGEMENT	15	% OF CONSTRUCTION COST		60,349
			SUBTOTAL –	108,628

AIR STRIPPER COSTS (FROM TABLE G.3.1)	98,010
TOTAL CONSTRUCTION COSTS	608,963

OPERATION & MAINTENANCE				
EFFLUENT SAMPLING	MOS	12	1,500	18,000
INSPECTION & REPAIR	MOS	12	1,000	12,000
MONITORING WELL SAMPLING	LS	1	20.000	20,000
		TOTAL ANNUAL O&M COST		50,000

PRESENT WORTH FACTOR (30 YEARS, 5%)	15.372	
PRESENT WORTH O&M COSTS		768,600
TOTAL PRESENT WORTH COSTS		1,377,563

TABLE G.3.1
MEDLEY FARM SITE
GAFFNEY, SOUTH CAROLINA
ALTERNATIVE GWC-2A AND GWC-3A
AIR STRIPPER

DESCRIPTION	UNITS	QUANTITY	UNIT PRICE ($)	TOTAL ($)
EQUIPMENT				
EQUALIZATION TANK	EA	1	5,000	5,000
PUMPS	EA	2	1,000	2,000
BAG FILTER	EA	1	500	500
AIR STRIPPER	EA	1	25,000	25,000
SAMPLING STATION	EA	1	2,500	2,500
		TOTAL EQUIPMENT COSTS –		35,000
INSTALLATION				
ELECTRICAL		10% OF EQUIPMENT COSTS		3,500
PIPING		10% OF EQUIPMENT COSTS		3,500
INSTRUMENTATION		15% OF EQUIPMENT COSTS		5,250
STRUCTURAL		20% OF EQUIPMENT COSTS		7,000
			SUBTOTAL –	19,250
POWER CONNECTION		LUMP SUM		20,000
TOTAL INSTALLED COSTS				74,250
FACTORED COSTS				
HEALTH &SAFETY		1% OF INSTALLED COSTS		743
BONDS & INSURANCE		1% OF INSTALLED COSTS		743
CONTINGENCY		15% OF INSTALLED COSTS		11,138
ENG/CONST. MANAGEMENT		15% OF INSTALLED COSTS		11,138
		FACTORED COSTS –		23,760
TOTAL PRESENT WORTH COSTS				98,010

TABLE G.4
MEDLEY FARM SITE
GAFFNEY, SOUTH CAROLINA
ALTERNATIVE GWC-3A
GROUNDWATER EXTRACTION SYSTEM, 15 GPM

DESCRIPTION	UNITS	QUANTITY	UNIT PRICE ($)	TOTAL ($)
CONSTRUCTION COSTS				
EXTRACTION WELL CONSTRUCTION	LF	700	120	84,000
WELL HEAD EQUIPMENT/CONTROLS	EA	7	3,850	26.950
DISCHARGE PIPING; 1-INCH	LF	2,000	6.33	12,660
DISCHARGE PIPING; 2-INCH	LF	1,000	7.00	7,000
SEEDING	LS	1	1,000	1,000
ELECTRICAL CONDUIT, WIRE, FIXTURES	LS	1	80,000	80,000
MONITOR WELL CONSTRUCTION	LF	450	100	45,000
DATA AQUISITION SYSTEM	LS	1	75,000	75,000
			SUBTOTAL –	331,610

FACTORED COSTS				
HEALTH & SAFETY	1 % OF CONSTRUCTION COST			3,316
BONDS & INSURANCE	1 % OF CONSTRUCTION COST			3,316
CONTINGENCY	10 % OF CONSTRUCTION COST			33,161
ENG/CONST. MANAGEMENT	15 % OF CONSTRUCTION COST			49,742
			SUBTOTAL –	89,535

AIR STRIPPER (FROM TABLE G.3.1)   98,010

TOTAL CONSTRUCTION COSTS   519,155

OPERATION & MAINTENANCE				
EFFLUENT SAMPLING	MOS	12	1,500	18,000
INSPECTION & REPAIR	MOS	12	1.000	12,000
MONITORING WELL SAMPLING	LS	1	20,000	20,000
		TOTAL ANNUAL O&M COST		50,000

PRESENT WORTH FACTOR (30 YEARS, 5%)   15.372

PRESENT WORTH O&M COSTS   768,600

TOTAL PRESENT WORTH COSTS   1,287.755

TABLE G.5
MEDLEY FARM SITE
GAFFNEY, SOUTH CAROLINA
ALTERNATIVE SC-1
NO ACTION (5-YEAR REVIEW OF REMEDY)

REMEDY REVIEW

EVERY 5 YEARS, $50,000 EACH

YEAR	PWF (5%)
5	0.7835
10	0.6139
15	0.4810
20	0.3769
25	0.2953
30	0.2314
	2.7820

PRESENT WORTH COSTS   139,100

TABLE G.6
MEDLEY FARM SITE
GAFFNEY, SOUTH CAROLINA
ALTERNATIVE SC-2
CAPPING

3 10   0440

DESCRIPTION	UNITS	QUANTITY	UNIT PRICE ($)	TOTAL ($)
ROAD CONSTRUCTION				
GRADING	SY	2,000	0.75	1,500
AGGREGATE (NO. 57 STONE)	CY	1,000	29.00	29,000
BIAXIAL GEOGRID	FT2	18,000	0.44	7,920
			SUBTOTAL –	38,420
CAP CONSTRUCTION				
CLEARING BRUSH	ACRE	1	2,550	2,550
CLEARING BRUSH AND TREES TO 12 INCHES	ACRE	2	3,625	7,250
COMMON CUT	CY	2,500	3.39	8,475
COMMON FILL	CY	6,100	10.21	62,281
SELECT FILL	CY	1,500	15.07	22,605
60-MIL TEXTURED HDPE LINER	FT2	65,000	0.77	50,050
COMPOSIT DRAINAGE NET	FT2	65,000	0.50	32,500
TOPSOIL	CY	1,500	29.17	43,755
EROSION CONTROL BLANKET	SY	7,300	3.50	25,550
ANCHOR TRENCHING	CY	100	10.33	1,033
			SUBTOTAL –	256,049
GEOTECHNICAL INSPECTOR				
FULL-TIME INSPECTOR	DAY	25	300	7,500
PROCTORS	EA	6	125	750
REPORTING	LS	1	4,000	4,000
SURVEYING	EA	3	7,000	21,000
QA/QC TESTING (5%)	LS	1	17,900	17,900
			SUBTOTAL –	51,150
SWALE & CULVERT CONSTRUCTION				
GRADING	SY	400	0.75	300
RIP RAP	CY	200	28.60	5,720
BIAXIAL GEOGRID	FT2	3,000	0.44	1,320
			SUBTOTAL –	7,340
SEEDING				
MOBILIZATION	EA	1	300	300
HYDROSEEDING	ACRE	2	2,000	4,000
			SUBTOTAL –	4,300
FENCING				
FENCE	LF	1,200	15.00	18,000
GATES	EA	1	1,000	1,000
			SUBTOTAL –	19,000

INSTALLED COST – 415,159

TABLE G.6.1
MEDLEY FARM SITE
GAFFNEY, SOUTH CAROLINA
ALTERNATIVE SC-2
CAPPING

DESCRIPTION	FREQUENC (MONTHS)	UNIT PRICE ($)	ANNUAL COST ($)
OPERATION & MAINTANCE			
FENCE INSPECTION & REPAIR	12	2,500	2,500
TURF MAINTANCE	4	2,000	6,000
DRAINAGE INSPECTION & REPAIR	6	4,000	8,000
SETTLEMENT SURVEY	12	2,000	2,000
ANNUAL COSTS			18,500
PRESENT WORTH O&M COSTS	PWF = 15.372		284,382

REMEDIAL PERIOD – 30 YEARS
INTEREST RATE – 5%

FIVE-YEAR REVIEW OF REMEDY (FROM TABLE G.5)   139,100

TOTAL PRESENT WORTH O&M COSTS   423,482

TABLE G.7
MEDLEY FARM SITE
GAFFNEY, SOUTH CAROLINA
ALTERNATIVE SC-3
SOIL VAPOR EXTRACTION

DESCRIPTION	UNITS	QUANTITY	UNIT PRICE ($)	TOTAL ($)
CONSTRUCTION COSTS				
SYSTEM PREPARATION	LS	1	15,000	15,000
MOBILIZATION & INSTALLATION	LS	1	125,000	125,000
CARBON	LS	1	25,000	25,000
STARTUP	LS	1	25,000	25,000
			SUBTOTAL –	190,000
OPERATION & MAINTANCE COSTS				
SYSTEM OPERATION	MOS	12	15,000	180,000
DECOMISSIONING	LS	1	24,500	24,500
			SUBTOTAL –	204,500
FACTORED COSTS				
HEALTH &SAFETY	3% OF CONSTRUCTION AND O&M COST			11,835
BONDS & INSURANCE	1% OF CONSTRUCTION AND O&M COST			3,945
CONTINGENCY	25% OF CONSTRUCTION AND O&M COST			98,625
ENG/CONST. MANAGEMENT	10% OF CONSTRUCTION AND O&M COST			39,450
			FACTORED COSTS –	153,855
CONFIRMATION SOIL BORINGS	LS			75,000

TOTAL PRESENT WORTH COSTS   548,355

REFERENCE: TERRA VAC, 1990

APPENDIX H

HELP EVALUATION OF CAPPING

MEDLEY FARM SITE

Evaluation of Capping Design Alternatives

Using the HELP Model

A cap is intended to minimize the flow of infiltrating rain water through the unsaturated zone and, in general, consists of three layers. The top layer consists of a vegetated or armored surface component to promote vegetative growth and drainage off the cover and a soil component of adequate thickness to assure that the underlaying layer is below the frost zone. The second layer is a drainage layer that effectively reduces the amount of water entering the low permeability bottom layer. The low permeability bottom layer is usually a synthetic HDPE membrane that may be underlain by a layer of compacted clay.

The performance of a proposed cap or design alternatives can be evaluated by the EPA HELP Model (Schroeder et. al., 1988). The model takes climatologic, soil, vegetative and design data as input and utilizes a mathematical model that accounts for the effects of surface storage, run off, infiltration, evapotranspiration, soil moisture storage, lateral drainage from the drainage layer and percolation. Percolation through the barrier layer is an indication of groundwater contamination potential.

Table H.1 contains values for typical input parameters. Porosity, field capacity, wilting point and soil water content were estimated by following recommendations found in literature (Schroeder et. al., 1988). The drainage layer is 200 mil composite drainage net with an estimated permeability of 20 cm/sec under a loading of 10,000 lb/ft^2. It is not expected that under field conditions such a high overburden load will be encountered. A permeability of 20 cm/sec is therefore a reasonable estimate. However, a permeability of 10 cm/sec was used to make the analysis further conservative. Permeabilities for the other layers are given in Table H.1.

Precipitation for the site was synthetically generated using standard corrections based on mean monthly precipitation data for Gaffney, South Carolina.

The purpose of the evaluation here is to compare the relative effectiveness of two capping designs featuring the following low permeability barrier options:

- 40 mil HDPE synthetic liner underlain by one foot of compacted clay

- 60 mil HDPE synthetic liner underlain by six inches of select fill

Although it is not expected that water will leak through the HDPE membrane, an assumption was made for the liner leakage fractions. For the 40 mil HDPE, it was assumed to be 0.01% and 0.001% for the 60 mil HDPE. Liner leakage fraction is the fraction of the liner surface that is defective and allows water to flow through it.

In modeling, both the top soil layer and the common fill layer underneath the low permeability barrier layer were ignored. The amount of percolation to the barrier layer is overestimated and the model's prediction of net percolation to groundwater is excessive.

Table H.2 presents results of the HELP model for the two different capping options. From the table it is evident that both capping options are effective in minimizing the flow of infiltrating rain water through the unsaturated zone underneath the cap. For option 1, the percolation through the barrier layer is effectively zero while for option 2, it is 0.01 inches. It is not expected that a head of 0.01 inches will have any significant impact on the groundwater quality. The net infiltration of 0.01 inches is an overestimate because of the overly conservative assumptions discussed previously. Actual infiltration beneath the 60 mil liner would be less. The two capping options would achieve an equivalent level of performance.

REFERENCES

Schroeder, P.R., Morgan, J.M., Walski, T.M., and Gibson, A.C., "The Hydrologic Evaluation of Landfill Performance (HELP) Model".

TABLE H.1: Typical values for input parameters

LAYER 1

Vertical Percolation Layer

Thickness	=	18 inches
Porosity	=	0.40 vol/vol
Field Capacity	=	0.24 vol/vol
Wilting Point	=	0.14 vol/vol
Initial Soil Water Content	=	0.25 vol/vol
Saturated Hydraulic Conductivity	=	10^{-4} cm/sec

LAYER 2

Lateral Drainage Layer

Thickness	=	0.20 inches
Porosity	=	0.70 vol/vol
Field Capacity	=	0.03 vol/vol
Wilting Point	=	0.02 vol/vol
Initial Soil Water Content	=	0.03 vol/vol
Saturated Hydraulic Conductivity	=	10 cm/sec
Slope	=	3 percent
Drainage Length	=	120 feet

LAYER 3

Barrier Soil Liner with Flexible Membrane Liner

Thickness	=	12 inches
Porosity	=	0.43 vol/vol
Field Capacity	=	0.36 vol/vol
Wilting Point	=	0.28 vol/vol
Initial Soil Water Content	=	0.43 vol/vol
Saturated Hydraulic Conductivity	=	10^{-7} cm/sec
Liner Leakage Fraction (60 mil HDPE)	=	0.001%

Table H.2: Comparative performances of the two capping options

Capping Option	Liner	Precipitation (inches)	Runoff (inches)	Evapotranspiration (inches)	Lateral Drainage (inches)	Percolation (inches)	Reduction in Infiltration
1	40 mil	50.03	2.80	35.24	11.99	0.00	100%
2	60 mil	50.03	2.80	35.24	11.98	0.01	99.92%

Topsoil (6" Thick)

Common Fill (18" Thick)

Filter Fabric

40 Mil HDPE
Membrane

Drainage Net ⟶

Compacted Clay (12" Thick)

Common Fill (Thickness Varies)

Existing Landfill
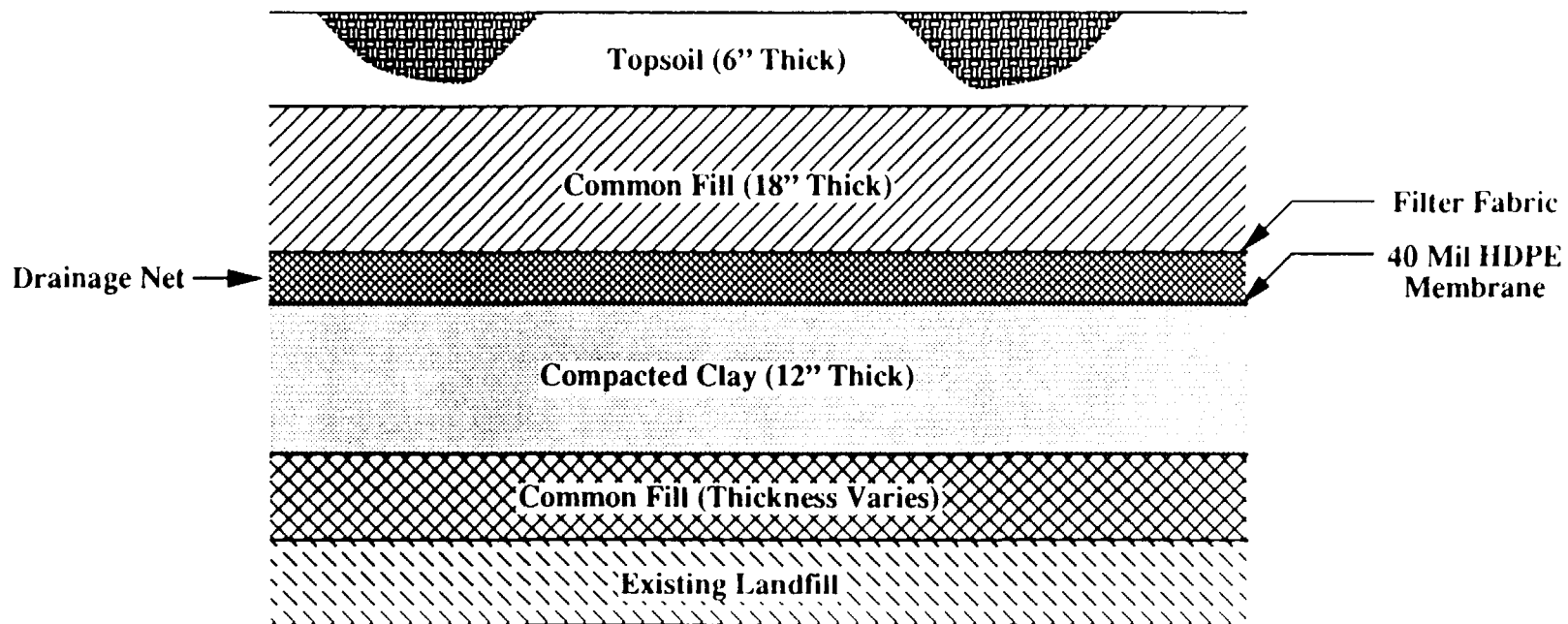
Not To Scale

310 0449
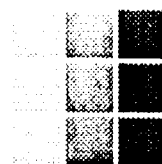
SIRRINE
ENVIRONMENTAL
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Figure H.1

Capping Option 1
40 mil HDPE with
12 inches of Compacted Clay

Topsoil (6" Thick)

Common Fill (18" Thick)

Filter Fabric

60 Mil HDPE Membrane

Drainage Net →

Select Fill (6" Thick)

Common Fill (Thickness Varies)

Existing Landfill
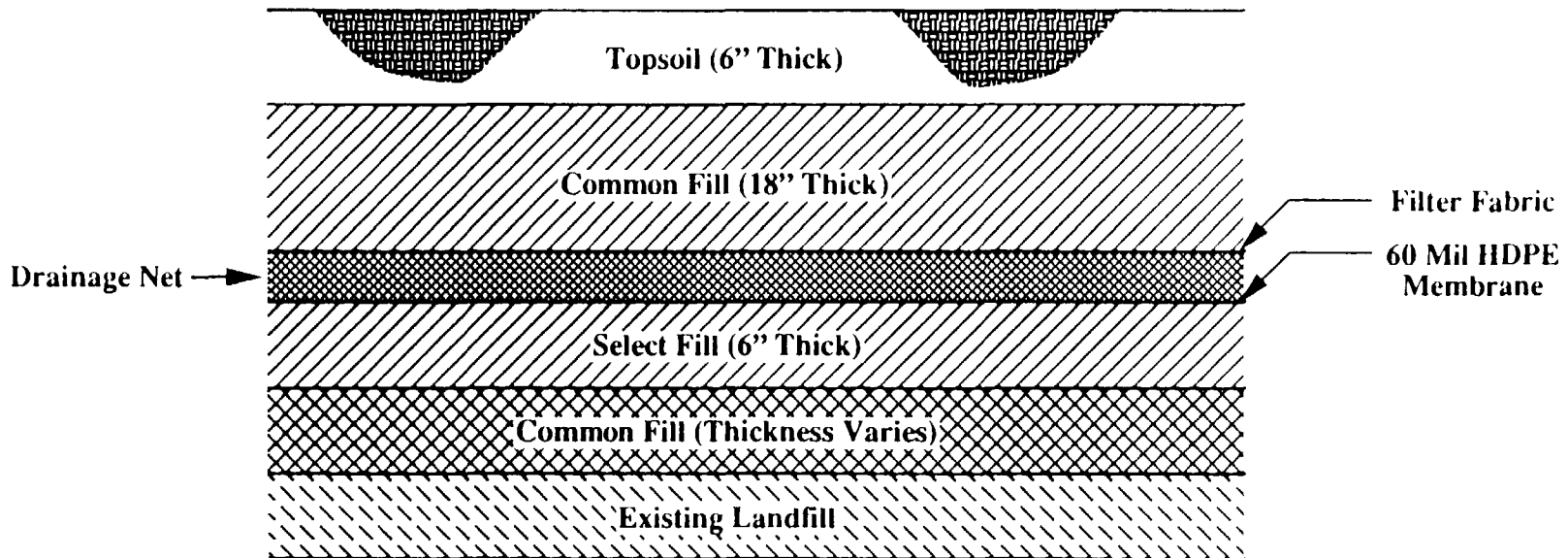
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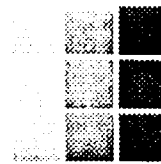
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Figure H.2

Capping Option 2
60 mil HDPE with
6 inches of Select Fill

APPENDIX I

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